The pricing and utilization of LEGUME AND GRASS SEEDS

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THE PRICING AND UTILIZATION OF LEGUME AND GRASS SEEDS

By William Herr and G. L. Jordan[1]

In choosing the grass and legume seeds to be included in this study, the first question was: "Which forage crops are best adapted to the northeastern quarter of the United States — or that area which includes Illinois?"

As can be seen from Fig. 1, there are five major areas of adaptation for forage crops in the United States, with Area 1 extending over the entire northeastern section. Following is a list of the grasses and legumes which are adapted to this area and commonly grown there:[2]

Grasses

Bluegrass, Canada	Foxtail, Meadow
Kentucky	Oatgrass, Tall
Bromegrass, Smooth	Orchard grass
Canary grass, Reed	Redtop
Fescue, Chewings	Ryegrass, Common
Meadow	Perennial
Red	Sudan grass
Tall	Timothy

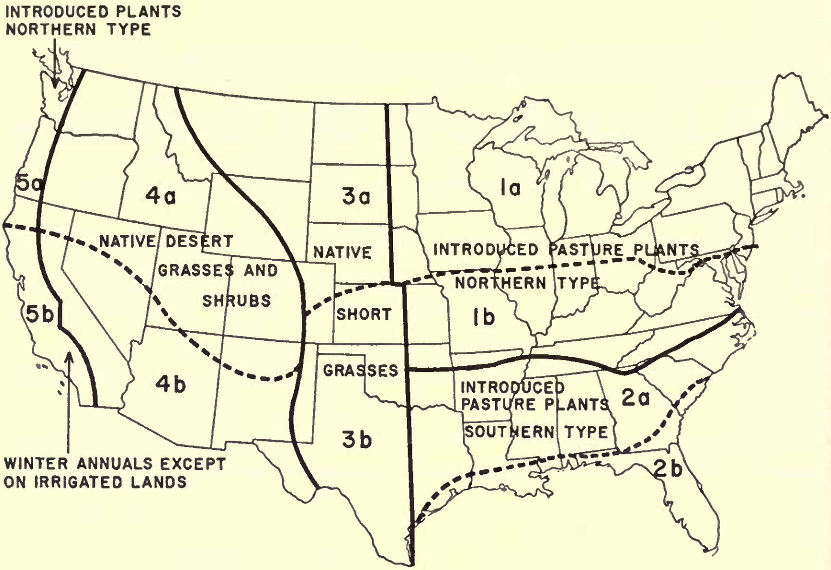
Legumes

Alfalfa	Clover, Alsike
Birdsfoot trefoil	Crimson
Lespedeza, Korean	Ladino
Common	Red
Sericea	Sweet
	Common white

To narrow the list still further, it was necessary to consider the relative importance of the different seeds. This, of course, can be computed on a number of different bases. It can, for example, be based on the acres harvested for seed or the acres that the forage seed produced will plant. The purpose that the seed will be used for also helps to determine its importance. If we were primarily interested in soil conservation we would choose a different measure than if we were interested in land utilization.

[1] William Herr, formerly Assistant in Agricultural Economics, and G. L. Jordan, Professor of Agricultural Economics.

[2] U. S. Department of Agriculture Yearbook for 1948. pp. 743-752.



Areas of adaptation for grass and legume crops in the United States (from U. S. Department of Agriculture Yearbook for 1948, page 743). (Fig. 1)

For this report, however, importance was determined on the basis of money value, as value is the important consideration from both the standpoint of the seed industry and that of the farmer. Table 1 shows the average annual value of the seed production for forage crops that are widely grown through the north central and northeastern states.[1]

From Table 1 it can be seen that the five legumes — red clover, alfalfa, lespedeza, alsike clover, and sweet clover — followed by the two grass seeds, Kentucky bluegrass and timothy, are most important from the standpoint of money value. Since data on bluegrass seed are limited, it could not be studied in much detail. This bulletin is therefore devoted primarily to a study of the other six seeds, dealing chiefly with the economics of production, factors influencing prices received by farmers, seasonal price movements, and marketing margins.

Other seeds which are increasing in importance, as indicated by a much larger value in 1950 than during the previous 10 years and also a larger value in 1951 than in 1950, include common ryegrass, crimson clover, Ladino clover, and tall fescue. Studies of these seeds, while desirable from the standpoint of their importance, are limited because of lack of data.

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[1] Data for annual values, 1940-1951, are given in Table 1 of a mimeographed supplement to this bulletin, which may be obtained by writing to the Information Office, College of Agriculture, Urbana, Ill.

Table 1. — Value of United States Field Seed Crops
(Limited to forage crops commonly used for hay and pasture)

Seed crops	Average value of production, 1940-1949	Value of production, 1950 (revised)	Value of production, 1951 (revised)
		1,000 dollars	
Red clover	29,190	45,306	27,385
Alfalfa	24,806	39,243	47,551
Lespedeza	15,131	12,504	15,067
Alsike clover	5,002	4,734	5,074
Sweet clover	3,927	10,041	4,818
Timothy	3,464	6,433	2,841
Common ryegrass	2,475	5,288	5,463
Crimson clover	2,066	6,231	7,519
Redtop	1,998	4,319	1,700
Sudan grass	1,695	2,587	2,687
Ladino clover	1,474	9,706	12,902
White clover	1,408	3,158	3,412
Bromegrass	1,358[a]	4,605	1,633
Orchard grass	1,098	2,384	1,923
Perennial ryegrass	518	750	762
Meadow fescue	139	218	109
Kentucky bluegrass	3,916	8,134	4,030
Tall fescue	2,854[b]	7,738	11,856
Birdsfoot trefoil	193[c]	516	480

[a] Eight-year average, 1942-1949.
[b] Two-year average, 1948-1949.
[c] Value for 1949 only.

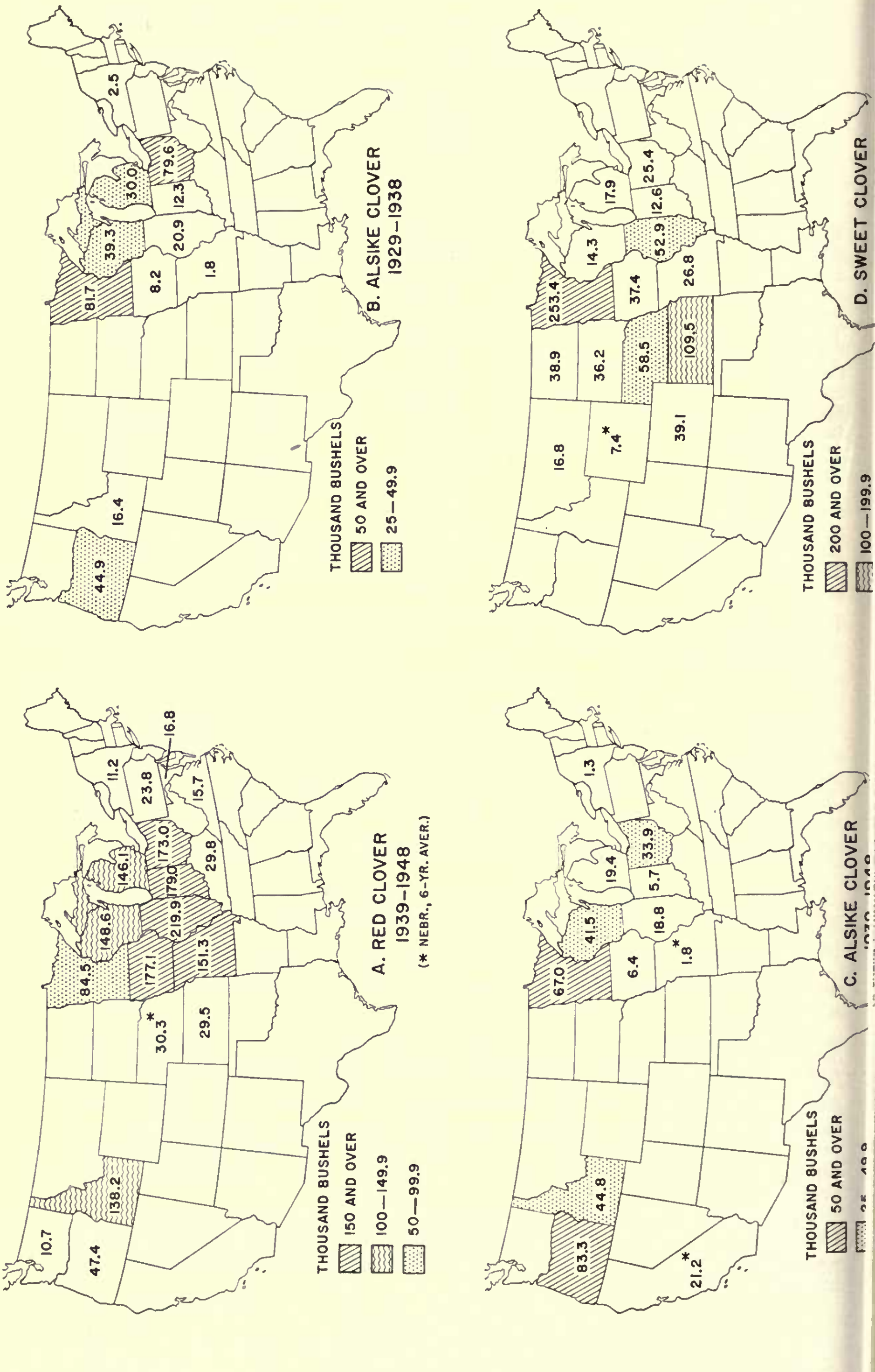
It is to be noted that the value of the six seed crops included in this study amounted to only one-third of 1 percent of the average U. S. gross farm income during the 10 years, 1940-1949. Despite this small fraction, they deserve attention because of the importance of forage seeds both in the production of feed and the conservation of soil.

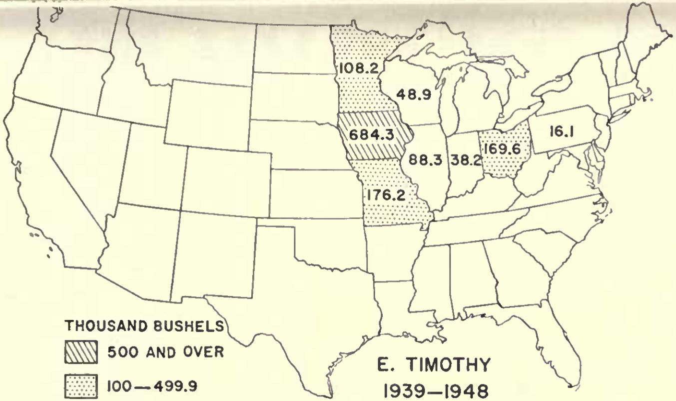
SEED-PRODUCING REGIONS[1]

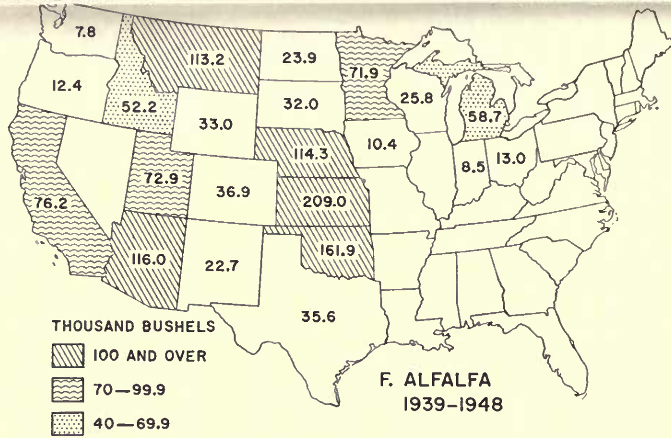
The leading states during the 10-year period, 1939-1948, in the production of the six forage seed crops studied are shown in Fig. 2.[2]

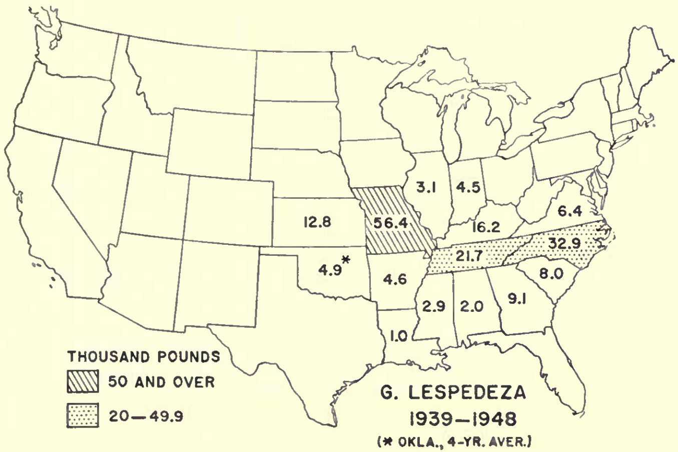
[1] For this section to be most fruitful, the reader should refer to Frank Beck's discussion of the location of seed-producing areas by decades in *The Field Seed Industry in the United States,* chapter 2, University of Wisconsin Press, Madison, 1944. The objective of the present discussion is to bring Dr. Beck's presentation up-to-date and to indicate any significant changes in the location of producing regions by analysis of the decade from 1939 to 1948. As seed production is highly variable in the short run, it is necessary to compute long-term averages.

[2] The decade 1939-1948 was chosen as it followed directly the decade 1929-1938, which was the last one studied by Dr. Beck (*see* footnote 1). Averages were calculated from the data given in Tables 2 to 7 of the supplement (*see* footnote 1, page 4).


B. ALSIKE CLOVER
1929–1938
THOUSAND BUSHELS
50 AND OVER
25—49.9
2.5
79.6
30.0
12.3
39.3
20.9
81.7
8.2
1.8
16.4
44.9
D. SWEET CLOVER
THOUSAND BUSHELS
200 AND OVER
100—199.9
25.4
17.9
12.6
14.3
52.9
253.4
37.4
26.8
38.9
36.2
58.5
109.5
16.8
7.4*
39.1
A. RED CLOVER
1939–1948
(* NEBR., 6-YR. AVER.)
THOUSAND BUSHELS
150 AND OVER
100—149.9
50—99.9
11.2
23.8
16.8
15.7
146.1
173.0
29.8
148.6
179.0
219.9
84.5
177.1
151.3
30.3*
29.5
138.2
10.7
47.4
C. ALSIKE CLOVER
THOUSAND BUSHELS
50 AND OVER
1.3
33.9
19.4
5.7
41.5
18.8
67.0
6.4
1.8*
44.8
83.3
21.2*







Average production of six major legume and grass seeds from 1939 to 1948, and of alsike clover seed from 1929 to 1938. (Fig. 2)

Red clover and alsike clover.[1] Production of red clover seed has not shifted significantly from the corn belt, although there has been some increase westward, especially to Kansas and Nebraska. There is, however, a definite trend toward the Pacific Northwest and California in the production of alsike clover seed, as can be seen by comparing Figs. 2B and 2C. In 1929-1938 this area produced 18 percent of the total alsike seed, while in 1939-1948 it produced over 46 percent.

Red clover seed is produced in the corn belt not because it yields any better here than in the West, but because it is harvested at a different time than most other crops, and thus offers an opportunity to use labor and machinery that would otherwise be idle. Production of red clover seed is therefore likely to be important in the corn belt as long as red clover occupies an important position in the regular rotation and is grown in relatively pure stands.

The situation can be explained further by analogy with oats production in the corn belt. Despite competition from areas farther north and west, where yields are better, oats are grown extensively through the corn belt because there is little competition for the resources of labor and capital during planting and harvesting.

There are several reasons why production of alsike clover seed is shifting to the West. For one thing, it is generally grown in combination with other grasses and legumes in the corn belt, and hence is not as readily adapted for commercial seed production as red clover. And even when it is grown in relatively pure stands, the seed yield is not so high in the corn belt as in the Northwest and California.

Another very good reason for the shift in production is the decreased demand in the Midwest. The custom of including alsike clover as a stand insurance in mixtures, particularly on wet spots, is becoming less common. It cannot compete with higher-yielding hay legumes, especially since the increased use of lime has made soils better adapted to alfalfa and red clover. Also, Ladino clover is being substituted for it in many forage mixtures.

Sweet clover. The production area of sweet clover seed has not changed significantly from the 1924-1928 period to the decade ending in 1948. There have been shifts among the leading producing states, but at present the ranking of the states has returned pretty much to the

[1] For the earlier decades, Dr. Beck treated red and alsike clover as one, recognizing that such a procedure was not ideal. By doing this he concluded that the two seed crops are grown in the same regions and are subject to the same demand factors. While it may be true that the areas of consumption are for practical purposes identical, the areas of seed production differ significantly.

1924-1928 average. From 1929 to 1938 the area of production was concentrated in Minnesota and North Dakota, but recently production has shifted somewhat south and west (Fig. 2D).

Timothy. The area of timothy seed production has been stable in the last three decades, with Iowa, Missouri, Minnesota, Illinois, and Ohio producing the major portion of the crop (Fig. 2E). The only apparent change has been the continuing downward trend in production. Of the major producing states, only Ohio produced more timothy seed in the most recent decade (1939-1948) than in the previous decade. Illinois production declined about 55 percent from 1929-1938 to 1939-1948, showing the largest relative decrease. Iowa showed the largest decrease in absolute amount, producing about 290,000 bushels less in 1939-1948 than in the previous decade.

Alfalfa. Commercial production of alfalfa seed continues to be concentrated in the West (Fig. 2F). There have, however, been pronounced changes in the ranking of the states, first because of insect damage, and second because of a movement toward irrigated regions throughout the West. Arizona, for example, has climbed up to third place as a result of increased production in irrigated areas. Other leading states, according to figures for the 1939-1948 decade, are Nebraska, Kansas, Oklahoma, and Montana. Idaho, meanwhile, has dropped from second place to tenth, its production in 1939-1948 being just about half of what it was in 1929-1938.

California's production in 1939-1948 was about 50 percent more than it had been in the previous decade. Production in California is likely to become more important as the transporting of hardy varieties to that state for seed production is increased and nonhardy varieties are planted in the corn belt as soil-improvement crops.

Production in Michigan has also risen significantly — from practically nothing in 1929-1938 to nearly 60,000 bushels in the following decade. There are two important reasons for this increase: one is the higher price of alfalfa seed in comparison with competing crops — mostly vegetables — that can be grown on the sandy soils of Michigan. The other is the wider use of alfalfa in rotations. Also, the rise in production coincides with the increased use of DDT and other insecticides.

Actually, Minnesota and Wisconsin, as well as Michigan, have increased their production of alfalfa seed over the previous decade. Information as to the influence of the so-called all-crop harvester on the growth of seed production in this area would be interesting. It is possible that alfalfa seed production in these states is taking on the pattern that red clover has in the corn belt (page 8), which is that no other crops are seriously competing for labor and harvesting equipment at harvest time and that the costs of these factors of production are therefore comparatively low.

An opposing tendency is the fact that a seed crop reduces the amount of hay produced. On dairy farms, hay is the important crop except when seed prices are high in relation to milk prices. In recent years (1948-1952), price relations have not favored the production of alfalfa seed, and production has decreased. In the future, it is likely that production in this area, while potentially significant, will vary depending upon relative prices.

Lespedeza. Changes, if any, in production areas of lespedeza seed are not readily determined. The leading producing states include the area just north of the cotton belt and south of the corn belt (Fig. 2G). There is some indication that the crop is increasing in importance west of this area, in Kansas and Oklahoma.

HISTORICAL ANALYSIS OF PRODUCTION, ACREAGE, YIELD, AND PRICES

The purpose of this part of the study is to analyze long-run factors that have influenced the production and prices of the major field seeds. This has been done by comparing series of seed production, yields, acreages harvested for hay and for seed, and price relatives.

The following three aspects of seed production and pricing were studied: (1) the relative importance of acreage harvested for seed in determining total production; (2) rate of increase, or decrease, of acreage harvested for hay and the respective rate of change in acreage harvested for seed; and (3) comparison of the prices received for these seeds with prices received for all crops by farmers.[1]

Production, yield, acres harvested for seed, and acres harvested for hay are shown on ratio charts so comparisons of rates of growth, or decline, can be made easily (Fig. 3).

Lespedeza. Of the six seeds studied, lespedeza showed the most rapid growth in production during the 1919-1951 period (Fig. 3). Actually, the really rapid growth occurred before 1939 — since that time, production has increased slowly. The acreage harvested for hay has followed pretty much the same pattern, with the leveling off starting after 1942.

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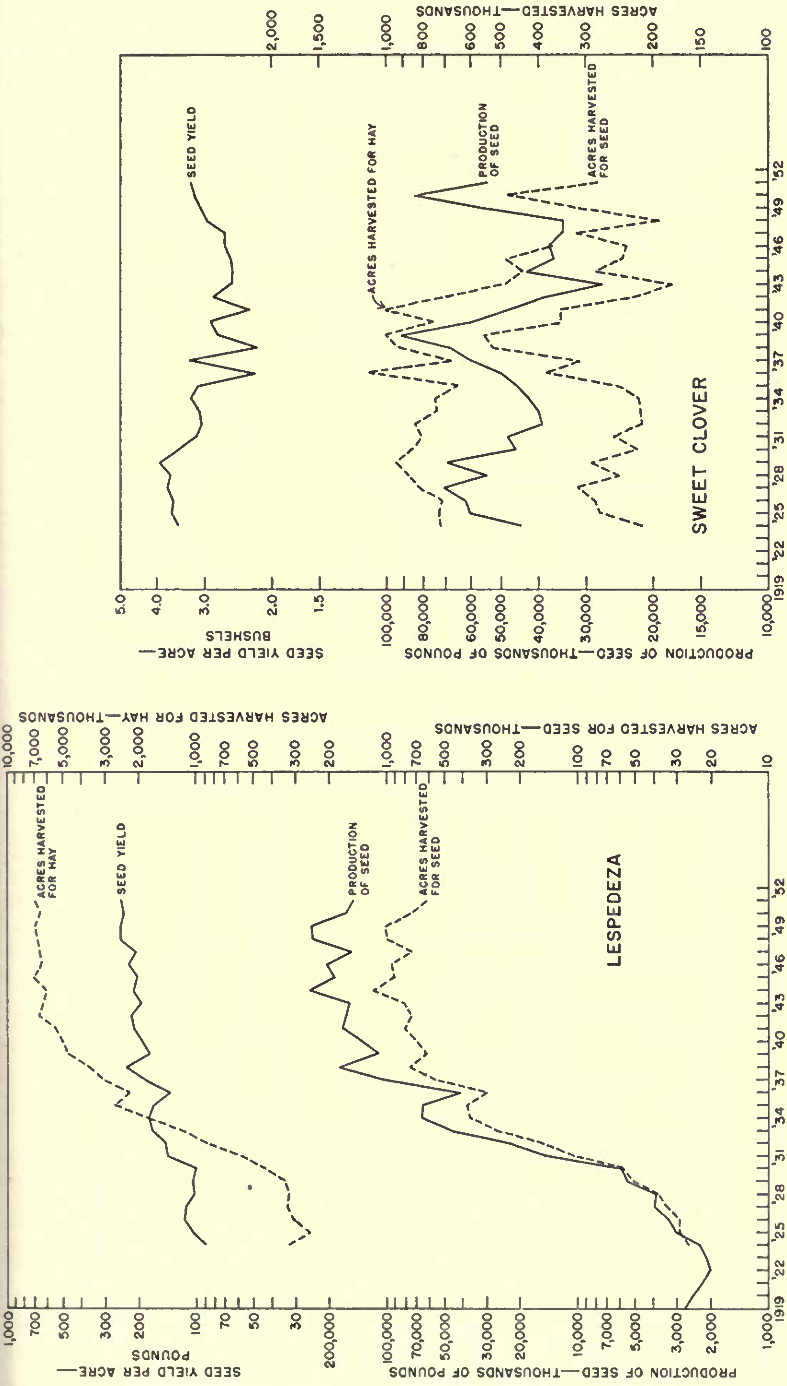
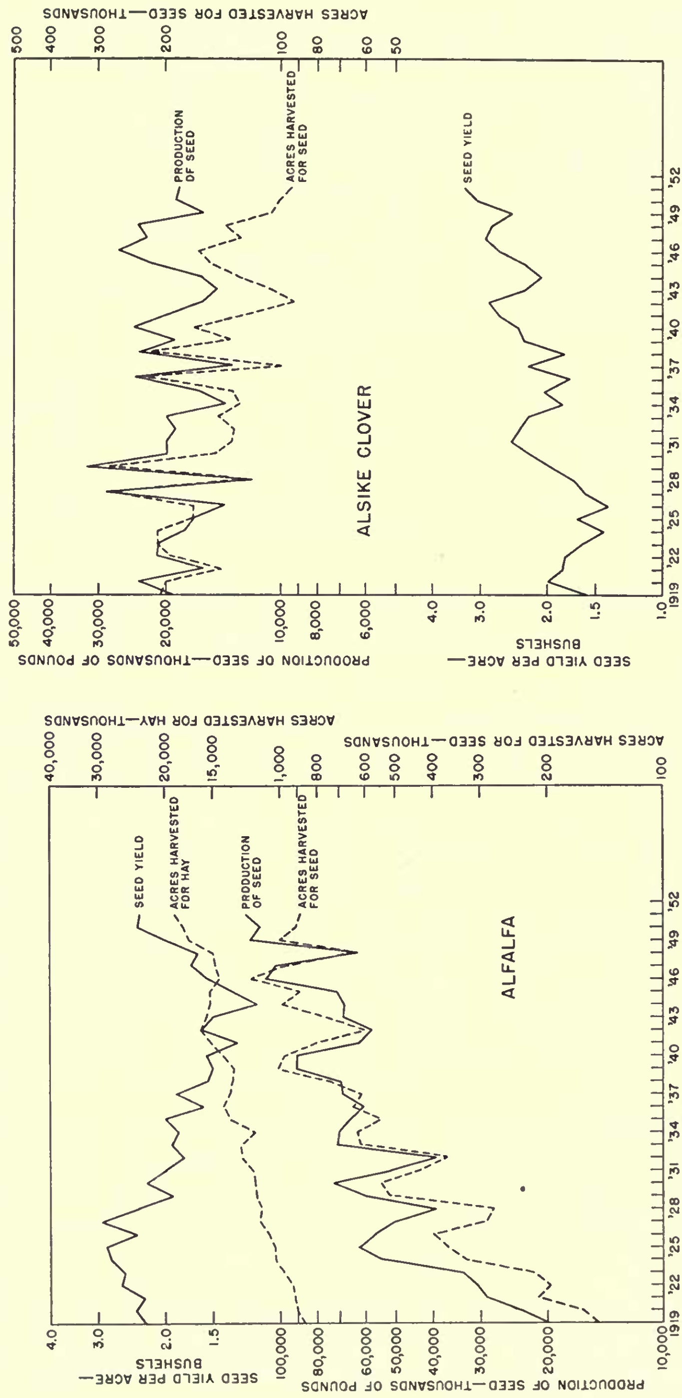
[1] Data pertaining to these series are given for each seed in Tables 8 through 15 of the supplement (*see* footnote 1, page 4).

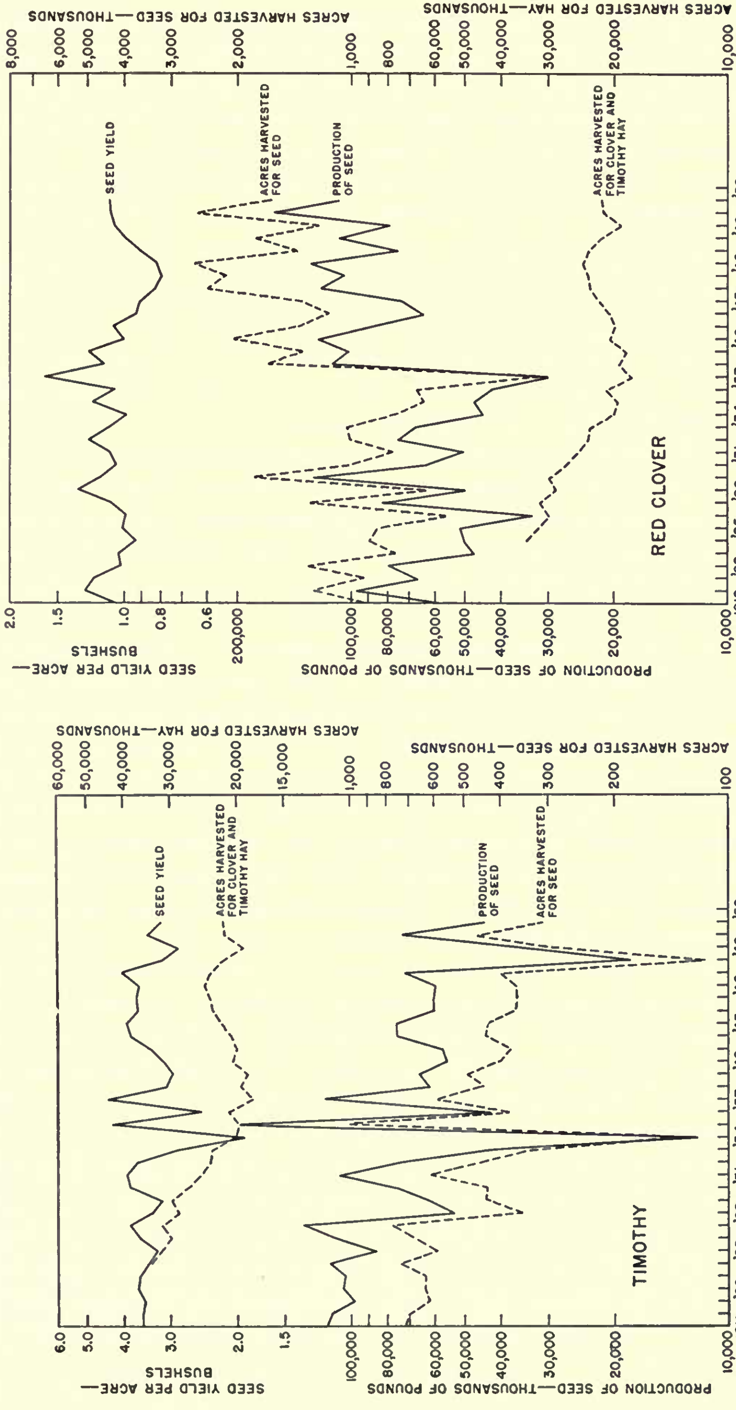


United States trends in hay acreage, seed acreage, seed production, and seed yield of lespedeza and sweet clover. (Fig. 3)

(*Fig. 3 is continued on next page*)



United States trends in seed acreage, seed production, and seed yield of alfalfa and alsike clover, and in hay acreage of alfalfa. (Fig. 3, continued)



United States trends in hay acreage, seed acreage, seed production, and seed yield of timothy and red clover. (Fig. 3, concluded)

Probably the decreasing rate of growth in seed production since 1939 is due to the continuing low price of seed compared with the price of all crops. This response of production to changing relative prices was caused by changes in acreages harvested for seed, as yields have shown a steady upward trend during the entire period.

Imports and exports of lespedeza seed during the period were too small to affect the trends noticeably and so are not considered here.

Sweet clover. Production of sweet clover seed decreased slightly in the 1924-1951 period, with three major peaks occurring during that time (Fig. 3). Acreage harvested for hay decreased noticeably from 1941 to 1947 (the latter was the last year the U. S. Department of Agriculture reported acreage of sweet clover hay). One important cause for this decline is the sweet clover weevil.

Partially offsetting the decline in use of sweet clover for hay is its increased use in recent years for soil improvement. The demand for sweet clover as a green-manure or catch crop would logically account for the fact that the acreage harvested for seed (and hence total seed production) has declined less rapidly than the acreage harvested for hay.

When a crop is used for soil conservation, it is not so integral a part of the farm business as when it is used for hay. Accordingly the demand for sweet clover as a soil-improvement crop can be expected to vary with farm income. As farm income rises, large quantities of the seed will be bought for soil conservation, erosion control, and maintenance of organic matter, for then farmers feel they can "afford" the added expense. In times of falling farm incomes, this expense is likely to be one of those eliminated early. Under these circumstances, the change in the character of demand for this seed has caused the income elasticity of demand to increase.

It would follow then, that if incomes of farmers fell materially while the production of seed remained the same, the price of seed would fall relative to the price of all crops. Conversely, the price would rise as income went up. In spite of the greater fluctuations in the prices of sweet clover seed, they still tend to follow the same general trend as the price index of all crops.

For a detailed price analysis of this seed, data are needed showing the quantity of sweet clover seed used for soil conservation or the acreage of sweet clover devoted to this purpose. Another influence which must be considered when analyzing the demand for this seed is the cost of nitrogen in commercial fertilizer, as commercial nitrogen and sweet clover seed compete with each other to a certain extent.

Yields per acre did not change significantly in the period studied, except that from 1938 to 1947 they were generally lower than in later or earlier years. One cause of this decline appears to be the large acreage harvested for seed. That is, as acreage increased during this period, it expanded through the use of land that was not too suitable for the production of sweet clover seed.

Foreign trade in sweet clover seed is mainly confined to imports, which, during the period studied, were equal to about 13 percent of the total production. Since the depression years, imports have been increasing, thus contributing to the situation already mentioned — that supplies are larger than are necessary to maintain the acreage of sweet clover hay.

Alfalfa. The trend in production of alfalfa seed has been upward at the rate of about 4.0 percent a year; at the same time the acreage harvested for hay increased at the rate of only 2.2 percent (Fig. 3). This means that an increasing proportion of the crop is used for green manure or pasture — assuming that the density of the hay stands and the length of the rotation have remained the same. There is, however, some evidence that many alfalfa stands are left down only two or three years instead of the six or seven years common a decade or two ago.

The increased production of seed has been due primarily to increased acreage, and this increased acreage has in turn been due to a favorable price for alfalfa seed relative to the prices of all crops. The additional acreage harvested for seed brought into use land which was not likely to be very productive for seed. An example of this has already been cited — the use of sandy land in the north central states (page 9). As a result of using less productive land, yields per acre tended to decline throughout the 30's and early 40's. There has, however, been a noticeable increase in yields since 1944, when they were at their lowest level.

Imports have averaged about 11 percent of total production during the period while exports have averaged only about 1 percent. Imports fell from high levels in the 1920's to a negligible amount in the early 1930's, but since 1935 they have risen steadily. The relatively high price of alfalfa seed is partly responsible for this increase.

Alsike clover. There are no data to show the utilization of this seed for hay. The significant fact is that production of this seed has been fairly constant over the 32 years studied. The acreage harvested for seed has had a downward trend, reflecting the movement of production toward the Northwest, where higher yields can be obtained (page 8). Yields per acre have shown a fairly steady growth since the mid-1920's (Fig. 3).

At the same time the price of alsike clover seed declined relative to the price of all crops. This factor has also contributed to the decline in acreage, especially in regions such as the corn belt, where yields are relatively low.

Foreign trade in alsike clover seed has not been so important in recent years as it was in the 1920's. From 1919 to 1951 imports averaged about 15 percent of production, fluctuating between zero and 65 percent.

Timothy and red clover. Because the harvested acreages of timothy and red clover hay are reported as one crop, the seeds of these crops are discussed together. The trend in production of timothy seed has been decidedly downward since 1919, while the trend in production of red clover seed has been upward (Fig. 3). The acreage of clover and timothy harvested for hay has shown a downward trend. Since production of timothy seed has declined at a faster rate than acreage of harvested hay, it is reasonable to conclude that the percentage of red clover in the hay mixture is increasing. In fact, there has been a shift toward stands of pure red clover hay.

For timothy seed there has been no significant trend in yield. Red clover seed yields, however, declined from 1940 to 1946. The increase in acreage harvested for seed during the war years tended to result in lower yields as areas were drawn into production which did not have the greatest advantage for growing this crop. Since 1946 yields have increased and are now back to normal.

Prices of red clover seed followed the fluctuations of the prices of all crops but tended to average higher in 1926-1928 and in 1934-1936. Timothy seed prices have also followed the index for all crops rather closely, with these exceptions: In 1934 and 1949, when production was unusually low, price relatives increased to 424 and 554 respectively. And since World War II, prices have declined relative to prices of all crops. This decline reflects the decreasing demand for this seed, which is due to the declining horse population and the introduction of superior grasses that are replacing timothy in the hay mixture. The character of these factors indicates that production of timothy seed will continue downward for some years to come.

The importance of foreign trade for red clover seed has varied tremendously over the period studied. In 1923, imports were more than 50 percent of the year's production, while in 1932, for all practical purposes there were no imports. Over the period studied, imports averaged about 10 percent of total production; exports averaged less than 2 percent.

Little timothy seed has been imported except in 1934, a year of very low production, when imports were almost 40 percent of total production. Even in 1949, also a year of low production, imports were less than 4 percent. Timothy, however, is the chief seed crop exported, and from 1922 to 1950 exports averaged over 15 percent of total production.

FACTORS INFLUENCING THE ANNUAL PRODUCTION OF FORAGE SEEDS

Variability in production of major crops is due mainly to fluctuations in yield.[1] But for the six seed crops studied fluctuations in acreage were more important than yield in causing major changes in production (Table 2). Yield, however, is more important than might at first seem apparent from Table 2, for fluctuations in acreage are caused partly by high or low prospective yields. When yields are expected to be low, the acreage harvested decreases because the only areas harvested are those with yields high enough to pay costs. But

Table 2. — Average Changes From the Preceding Year in Production, Acreage Harvested, and Yield of Seed Crops, United States, 1931-1950[a]

Seed crop	Average change in production	Average change in yield	Average change in acreage
		percent	
Alfalfa	21.77	12.46	22.25
Red clover	42.53	12.90	53.18
Sweet clover	22.45	12.02	25.51
Alsike clover	22.71	12.99	25.87
Lespedeza	39.77	11.55	27.17
Timothy	117.81	22.37	61.30

[a] Calculated by averaging, for the 20-year period, the percentage by which production, yield, or acreage changed each year from the preceding year.

if the seed crop promises to yield high, more acreage is likely to be harvested. As a result, we are unable to determine the total effect of changes in yield on total production.

If we could predict changes in acreage harvested for seed we could estimate with some degree of certainty the total production of seed for a coming year. (This does not, of course, hold true of other crops as yields fluctuate and are not readily predictable.) It is therefore

[1] Waite, Warren C., and Trelogan, Harry C. Agricultural market prices, 2d ed. John Wiley and Sons, Inc., New York, 1951. p. 65.

important to determine the factors that influence farmers in deciding what acreage to harvest.

As already mentioned, prospective yield is important in determining changes in acreage. It would seem likely that prospective price is also a deciding factor, and that the previous season's price might be a measure of what farmers would expect the next year's price to be.

Studies were accordingly made with red clover to indicate the extent to which the variation in acreage harvested may be explained by the previous season's price. The acreage of red clover harvested for seed in Illinois was expressed as a percentage of the trend value. The purchasing power of red clover seed was calculated by dividing the price relative of red clover seed in Illinois by the Illinois price index of feed grains and hay (indexes adjusted to 1935-1939 = 100).

If the acreage of red clover seed harvested is dependent upon the purchasing power of last year's crop, there should be some correlation between the two. But inspection of a scatter using the purchasing power as the independent variable shows little correlation between this variable and the acreage harvested for seed the next year. If the residuals from this regression were plotted with red clover seed yield as a second independent variable, one would expect that a higher percentage of the variability of acreage harvested would be explained. This, however, was not the case.

One reason for these negative results is that previous season's price is not the same thing as prospective price; nor is yield received the same as anticipated yield.

Studies made at Purdue University indicate that the acreages of other crops are affected by the previous season's price, although the changes may be very small. Some evidence was found that truck and special crops respond more to this factor than other crops, but even so, only a small percent of total year-to-year variation in acreage could be explained by previous season's prices or purchasing power of the commodity.[1]

Other things no doubt affect acreage harvested to a greater extent than the purchasing power of seed the previous year. But, like prospective yield and prospective price, some of these factors are not statistically measurable. Significant statistical results may be obtainable with other factors, but an intensive study would have to be undertaken. Because of the characteristics of field seed crops as opposed to other major field crops, we believe it may be possible to predict production more accurately than is possible for other crops.

[1] Kohls, R. L., and Paarlberg, Don. The short-time response of agricultural production to price and other factors. Ind. Agr. Exp. Sta. Bul. 555. p. 7.

SEASONAL PRICE VARIATIONS

Seasonal price indexes were calculated for five of the seed crops studied — not enough data being available to calculate an index for the price of alsike clover seed. Prices received by Illinois farmers were used for calculating indexes for red clover, timothy, sweet clover, and lespedeza; United States average prices were used for common alfalfa.

The prices of all five crops reached their peaks sometime during the spring and their low points in late summer or fall (Table 3 and Fig. 4). The variations in price were particularly pronounced for sweet clover, timothy, and lespedeza. The bulk of the seed for these crops is sown in the spring and harvested in late summer or early fall. Thus demand is strongest in the spring, after which it declines until fall, when there is a slight upturn, depending on the extent of fall seeding. The supply of the seed is largely determined at harvest time although minor changes occur during the year, depending on exports and imports. The net result of these forces is that the strong demand in spring raises the price in this season, after which the approach of a new crop, together with the decrease in demand, causes prices to fall. The seasonal low for lespedeza comes later than for the other seed crops as the bulk of the seed is produced farther south and harvested somewhat later.

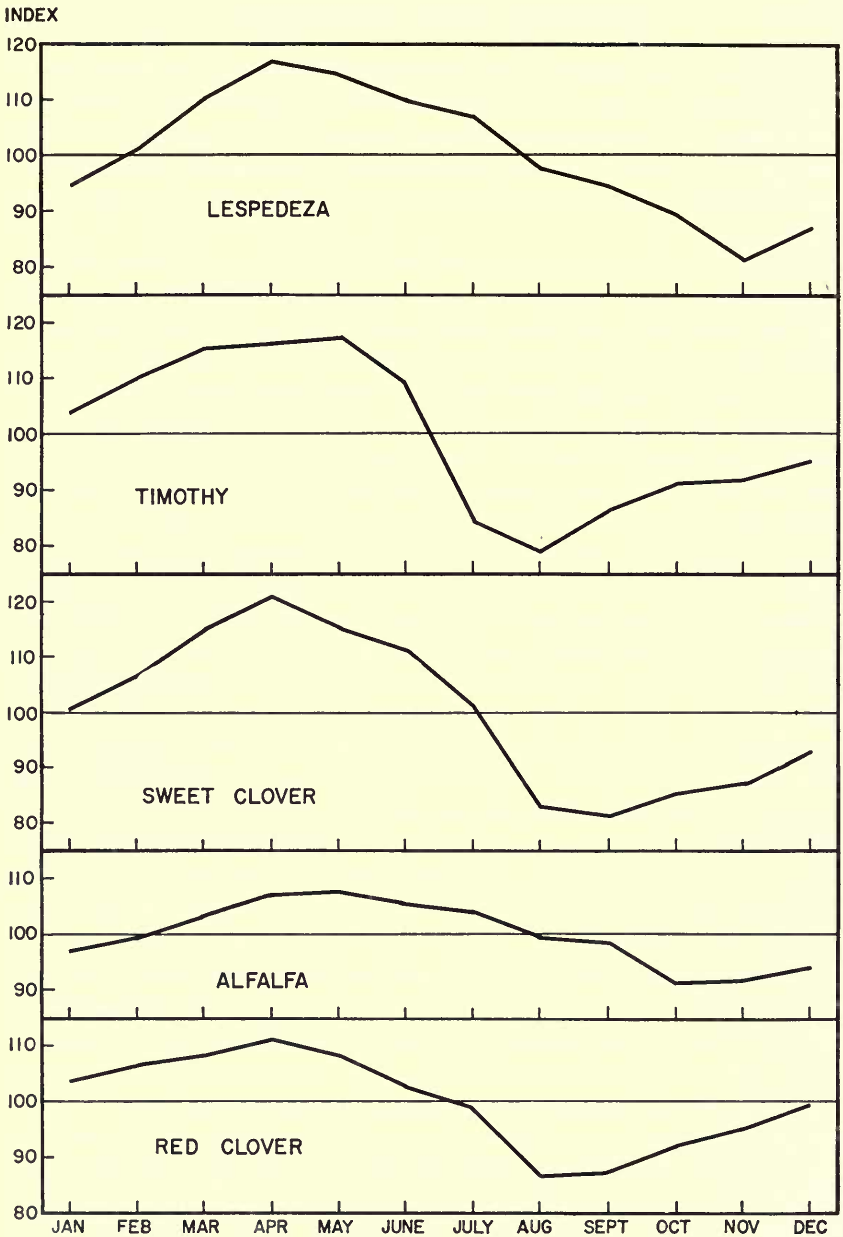
As the indexes for alfalfa seed were based on United States prices, they would be expected to fluctuate less than the indexes for other seeds. Planting and harvest dates vary over the country, so that their effects tend to cancel each other. In the South, alfalfa is often fall-sown, while farther north it is more likely to be spring-sown in oats. Similarly harvest dates would not be the same in Montana, for example, as in Arizona.

Inspection of monthly seed prices in Illinois each year indicates that variation is greater during the months of harvest and immediately thereafter than during the spring. This is due to the uncertainty

Table 3. — Monthly Price Indexes of Five Forage Seeds[a]

Crop	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Sweet clover	101	107	115	121	115	111	101	83	81	84	87	94
Timothy	104	110	116	116	118	109	84	79	86	90	92	96
Lespedeza	94	101	110	117	114	110	106	98	94	89	81	87
Red clover	104	107	108	111	108	103	99	86	87	92	95	99
Alfalfa	97	99	104	107	108	105	105	100	99	91	92	94

[a] Based on Illinois price received except for alfalfa, which is based on U. S. price received. Indexes for sweet clover, timothy, and red clover calculated by ratio to 12-month moving average on basis of July, 1934-June, 1950, omitting July, 1941-June, 1947; those for alfalfa calculated in same way but based on July, 1931-June, 1951, omitting July, 1941-June, 1947; those for lespedeza calculated by link relative method for January, 1937-December, 1950, omitting 1942-1946.



Seasonal price indexes in Illinois of lespedeza, timothy, sweet clover, and red clover seeds, and United States seasonal index of alfalfa seed. (For periods that indexes are based on, see footnote to Table 3.) (Fig. 4) of both supply and demand at the beginning of a new season and the corresponding price risk to anybody buying seed in the fall and holding it until spring.

The large fluctuations between the spring and the fall are due partly to the fact that there are no futures markets or other effective devices for hedging price risk. By assuming the price risk and other storage costs from the date of harvest until seed is sold in the spring, dealers discount the price to the farmers when they buy seed in the fall. Since a large proportion of seed is sold to dealers soon after harvest, it is apparent that they are the ones who benefit from the usual seasonal price rise.

The extent of seasonal price fluctuations in Illinois indicates that farmers with seed to sell would do well to store it until spring. Although exact storage costs are not known for the seeds included in this study, it is recognized that the costs are fairly low as legume seeds can be stored for two years and grass seeds for three years with a minimum amount of care, provided they are in a dry shed that is free from insects and rodents. At least, farmers who can meet these storage conditions can generally afford to store their seed crops until spring, if not longer.

Insofar as retail prices for seed follow the same general pattern as the prices received by farmers, those farmers who intend to buy seed for spring sowing would do well to buy it early and store it until planting time — provided, of course, clean seed is available. Examination of retail prices for the four crop seasons of 1950 through 1953 indicates that in three of the four years, farmers would have saved about $1.90 per 100 pounds of timothy seed by buying it in the preceding September rather than in March. Buying red clover seed, they would have been ahead two of the four years, for an average annual savings of approximately $1.75 per 100 pounds. Data for alfalfa seed do not all point in the same direction. For improved varieties, the average annual savings may have been significant, while for common alfalfa seed there may have been an actual loss.

Farmers cannot always buy early, since much of the seed is not processed and ready to sell until shortly before planting time. Furthermore, even when they can get seed early, they may not be convinced of the advantage of doing so. The annual cost of forage seeds is a relatively small cash outlay on many farms and hence farmers are not likely to scrutinize this cash expenditure as carefully as they do their feed or labor bills. Farmers who grow these crops for seed are more likely to be interested in seasonal patterns as the price received may be a fairly important element in their incomes.

PRICE ANALYSIS OF SIX FORAGE SEED CROPS

Demand factors affecting seed prices

A number of factors affect the demand for forage seeds and hence the price. These include livestock numbers, crop rotations, gross farm income, and, to a limited extent, personal income. From these factors it was necessary to choose one that could be used in the price analysis as a measure of the demand for forage seeds. Such a factor would have to be both measurable mathematically and reasonably accurate. Analysis of the different factors led to the selection of gross farm income as the best available measure of demand. Following are brief analyses of the major factors affecting seed demand.

Livestock numbers. It is commonly supposed that the demand for field seeds is closely related to the demand for hay and pasture to feed livestock. As shown by correlation studies by Henry Schultz,[1] the demand for hay in turn depends on the price of hay, the price of other feeds, and the number of animal units. Changes in cattle numbers are followed, with appropriate lags, by changes in the production of hay. Similarly, Gordon Butler has shown that the amount of acreage harvested for hay depends largely on the number of hay-consuming livestock units.[2]

These studies indicate that changes in the number of forage-consuming animal units might be a major factor in the demand for field seeds. Before giving this factor too much weight, however, it must be remembered that Schultz and Butler were both dealing with harvested acreage of hay, not with the entire acreage planted for forage. Harvesting a hay crop to feed a known quantity of livestock during the coming winter is a different matter from planting seed to be used for hay several years in the future. The amount of forage seed planted in any one year may be more closely related to the type of rotation followed than to livestock numbers.

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[1] Schultz, Henry. The theory and measurement of demand. Ch. 9: The demand for hay. University of Chicago Press, 1938. (Karl Fox in an analysis of factors affecting the price of hay included in the demand factor cash receipts from sales of dairy products and beef cattle weighted in proportion to hay consumption. To the extent that cash receipts are related to total numbers of cattle in these two classes, this demand index also includes numbers of forage-consuming livestock. See Fox's article, "Factors affecting farm income, farm prices, and food consumption," in *Agricultural Economics Research,* U. S. Dept. Agr. Bur. Agr. Econ., July 1951.)

[2] Butler, Gordon Gray. Changes in feed crop acreages. Field Seed Institute of North America, Madison, Wis., June 1943 (processed).

Length and stability of rotation. The six seeds studied are consumed largely in the northeastern and central portions of the country, where some kind of rotation is generally followed. As acreage planted for forage is related to the rotation, a major factor in determining the quantity of seed demanded is the length and stability of the rotation.

A three-year rotation such as a 1-1-1 (intertilled crops-small grain-legumes) will require forage seed for 33 percent of the land each year, while a 2-1-2 rotation will require seed for 20 percent of the land. Red clover and timothy seed are in greater demand for short rotations than long ones; while alfalfa and smooth bromegrass are used more in long rotations.

Once a rotation is established, it is not easily changed — usually sudden alterations come only as the result of adverse weather conditions or major economic changes, although there may be gradual changes resulting from technological developments in the use of legumes, especially for soil improvement. The demand for forage seed should therefore be relatively constant, reflecting the stability of the rotation.

Disposable personal income. As most farm products are ultimately consumed for food or clothing, the measure of demand used for them has often been disposable personal income. This, however, was not considered a good measure of the demand for legume and grass seed.

For one thing, seeds are not sold as a final product to consumers; nor are they sold as raw material to an industry to be converted directly into consumable products. Legume and grass seeds are sold to farmers primarily to grow hay or pasture to feed stock which in turn may be sold for consumption or used as breeding stock to produce more stock. As the demand for hay and forage seeds is a derived demand, time lags can be expected between changes in demand for animal products and in the demand for hay and forage seed. These lags will shift over time depending on the type of change: When cattle numbers are being built up, a different lag will probably be involved than when cattle numbers are being reduced. It would not be easy to adjust data to these changing conditions.

In addition, it must be remembered that some legume and grass seeds are used for soil-improvement purposes and that disposable personal income would not reflect this demand.

Gross farm income was considered to be a better measure of the demand for forage seed than disposable personal income.

One reason is that it reflects the profitableness of the present farming system, including the rotation. As already mentioned, the rotation, once it is established, is usually changed only after major shifts in income. As long as the gross farm income shows only relatively small year-to-year changes, the demand for forage seed should remain about the same, provided there are no pronounced technological changes that would affect the amount of legumes in the rotation.

This measure of demand also includes some indication of the demand for seed for soil-improvement purposes. Farmers are most likely to use seeds for soil improvement when their incomes are high. As incomes decline they are likely to increase production of other crops and cut their expenses by buying less seed for soil improvement.

As income from field seeds is included in gross farm income, some intercorrelation between farmers' income and prices of seeds occurs. The income from seed, however, makes up only a small fraction of total income.

Variations in demand

So far we have considered general measures of the demand for forage seeds throughout the country. However, the demand picture in a particular area or for a particular kind of seed may differ from the general demand of the country as a whole.

Variations among areas. In the dairy area of the Northeast, the number of dairy cows fluctuates much less than do cattle numbers in the Plains area and the fattening areas of the corn belt. In the West, changes in price and fluctuations in weather and feed supplies cause large movements of cattle from one area to another within a short period of time. And even without such changes, the time required to fatten cattle for market is much shorter than the productive period for dairy cows. The result is that demand for forage in the West undergoes periodic changes while the Northeast has more of a constantly increasing demand. The increase in population, if nothing else, would tend to increase the demand for milk.

Sudden changes in weather and available feed cannot, of course, be forecast, but they do condition responses of farmers in later periods. A drouth in the Plains states will cause feeder calves to be shipped out to other areas with more favorable climates. As a result, demand for field seeds increases not only in the drouth areas but also in the area with more favorable climate, as pastures may be overgrazed and need to be reseeded the following year.

Variations among different seeds. The demand for a particular seed may not be adequately represented by an index of demand suitable for other forage seed crops. This may be true of sweet clover, for example, which is utilized in large quantities for soil improvement as well as for forage.

Another problem that must be considered is the substitution possibilities between the various legume seeds. Seedsmen recognize that the various seeds are competitive and consequently price them in relation to one another. Hence prices are adjusted in accordance with the quantities not only of the particular seed but also of competing seeds. In some areas, the five major legume seeds all compete with one another. But climate, soil conditions, and disease problems limit the adaptability of some legumes to different regions. Only one or two of the major legume seeds may be adapted to a particular area and they may compete with a legume that is minor in the country as a whole but that is of great importance in the area. Such a situation prevails to a certain extent in parts of the Northeast, where birdsfoot trefoil may compete with alfalfa and red clover. As a result, the prices of the two major legume seeds will operate differently than when they are in direct competition.

Supply factors affecting seed prices

Domestic production accounts for most of the supply[1] of seeds. The importance of foreign trade varies from year to year. Timothy is the only seed studied which is exported[2] in very large amounts, but all seeds except lespedeza have been imported in significant quantities in particular years (Table 4).

Since seeds can be easily stored from one year to the next, stocks are important. However, data on seed carry-in before 1939 are limited, and the figures obtained since then do not cover a long enough time to allow a valid analysis. Table 4 shows the average percentage that carry-ins were of production and also the range in percentage from 1939 to 1951.[3] The importance of carry-ins is indicated by the fact that in 1948 the carry-in of timothy seed was greater than the production.

Since results from correlations to determine the factors affecting prices are sometimes more significant when consumption series are used, it would be desirable to derive these data. However, the fact that stocks of seeds before 1939 are not known poses a difficulty.

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[1] "Supply" as here used refers to quantity: It is not used in the sense of a supply schedule.

[2] While exports often represent a measure of demand, in this study they have been considered as a deduction from total quantity available to domestic consumers.

[3] Complete data for each seed for each year are given in Table 16 of the supplement (*see* footnote 1, page 4).

Table 4. — Percentages That Exports, Imports, and Carry-in[a] Were of Seed Production for Six Forage Seed Crops

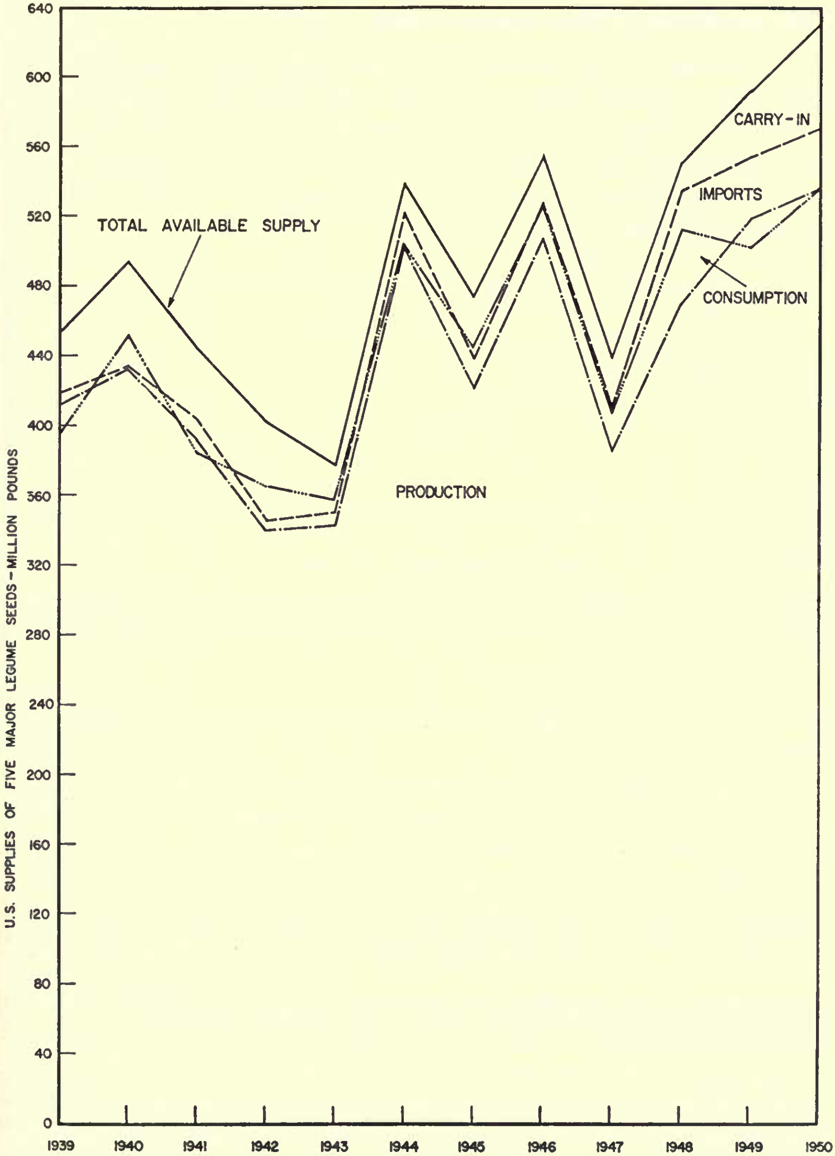
(Period covered for carry-in was 1939-1951; for imports, 1919-1951 unless otherwise specified; for exports, 1922-1951)

Seed crop	Percentage imports were of production		Percentage exports were of production		Percentage carry-in was of production	
	Range	Average	Range	Average	Range	Average
Alfalfa	0.1—94	11	0.5—5	1	3—21	11
Timothy	0—40	1	2—55	15	1—124	38
Red clover	0—52	10	0.3—11	2	1—31	10
Alsike clover	0—65	15	......	..	2—32	13
Sweet clover	0—79[b]	13[b]	......	..	5—38	15
Lespedeza	......	..	......	..	1—20	7

[a] Percentages for carry-in were calculated from Table 16 of the supplement (*see* footnote 1, page 4).
[b] From 1923 to 1951.

One possible method of deriving consumption series would be to take the average annual harvested acreage of a crop — alfalfa hay, for example, and divide it by the average number of years in the rotation. This would give the number of acres planted for the year. Multiplying this by the average rate of planting per acre would give the total alfalfa seed planted for hay for the year. It is obvious, however, that averages for the number of years in the rotation and the average planting rate are practically meaningless when they cover wide areas, even so much as one state. Also, seed planted but not harvested for hay is not included. It is therefore believed that any such consumption series would introduce less reliable data than those obtained from a supply concept which does not include changes in stocks.

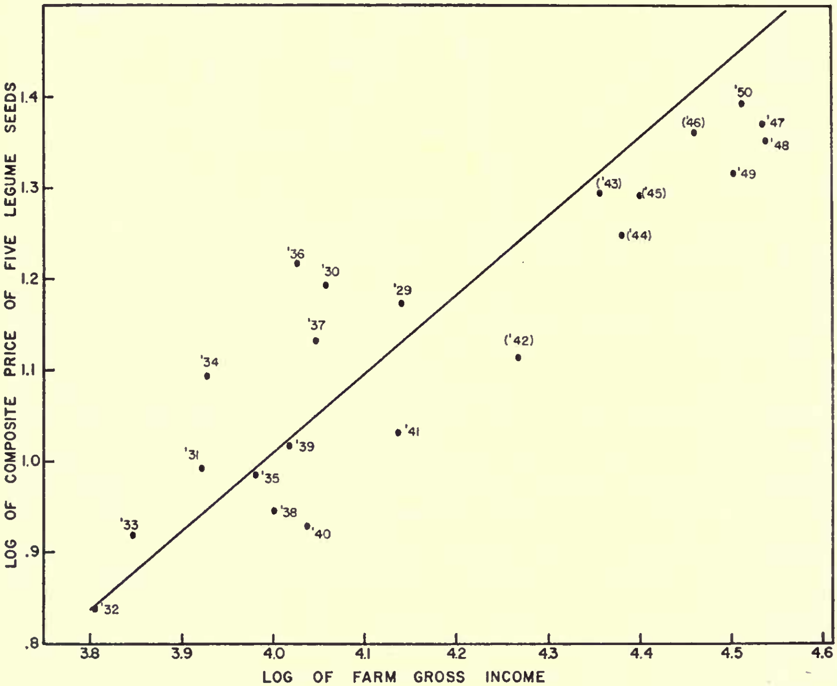
A second alternative for deriving consumption data would be to relate consumption to a supply or production series derived from the data since 1939. Domestic consumption would equal (production + carry-in + imports) — (carry-over + exports). A graph of consumption data of the five major legume seeds derived in this way is shown in Fig. 5. Inspection of this graph shows that consumption tends to follow the fluctuations in production as well as in total available supply, although the relationship between these series is not constant from one year to the next. In addition, it should be noted that five of the 13 years were war and price-control years and hence not subject to normal economic forces. This leaves only eight non-war years for which carry-in data are available. Since the data on carry-ins were so limited, it was decided to include just production and imports in the supply concept rather than to estimate consumption on the basis of only eight years of data.



Relationship of the United States consumption of five major legume seeds to the total available supply, 1939-1950. (Fig. 5)

Price analysis of five legume seeds

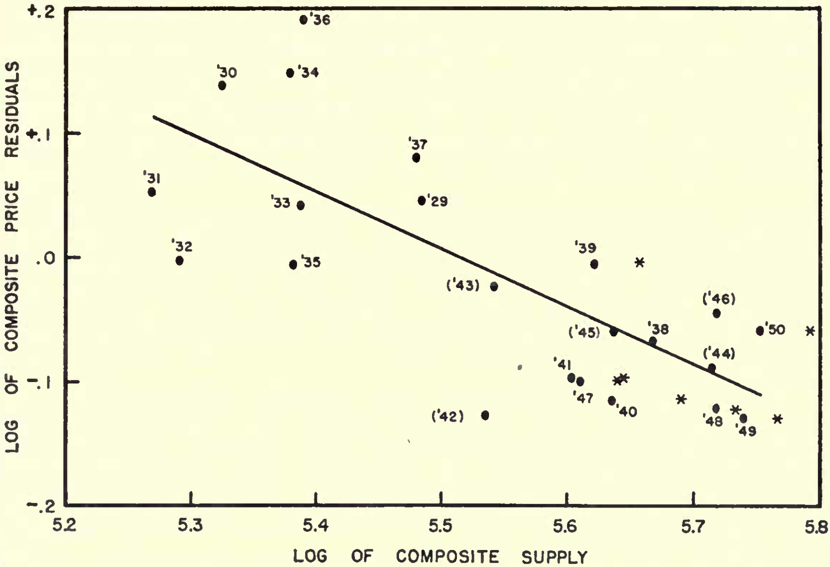
To account for the substitution possibility the five major legume seeds were combined into a composite. The composite price was computed by totaling the value of production for each of the five seeds and dividing by the total production of the five seeds in pounds. Hence the resulting composite price received by farmers per pound is weighted by the production of each seed.



Relationship of the logarithm of composite price of five legume seeds to logarithm of farm gross income in the United States, 1929-1950. (Fig. 6)

Figs. 6 and 7 show the relationship of the logarithm of composite price to the logarithms of farm gross income and of composite supplies.[1] Logarithms were used as it appeared that the changes in the variables were proportional. The logarithm of the composite price is treated as the dependent variable and the logarithms of farm gross income and supplies as the independent variables. The war and price-control years

[1] Data for the correlation are given in Table 17 of the supplement (*see* footnote 1, page 4).



Relationship of the logarithm of composite price residuals of five legume seeds to logarithm of composite supplies in the United States, 1929-1950. (Fig. 7)

from 1942 to 1946 were left out of the analysis, although they were plotted and placed in brackets.

The regression line through the scatter of the logarithms of composite price on the logarithms of farm gross income indicates that the price of the composite increases 0.86 percent with a 1-percent increase in farm income (Fig. 6), while the regression through the scatter of logarithms of price on logarithms of production plus imports indicates that the price of the composite decreases 0.46 percent with a 1-percent increase in supplies (Fig. 7).

The percentage relationship between price and supplies indicates an elastic demand for this composite of seeds. It must be remembered, however, that supply was necessarily defined as production plus imports, since figures on carry-in were not available before 1939 (page 26). Since carry-in is often a large fraction of the total quantity of some seeds, the supply concept used does not give a completely accurate picture. If it were possible to include carry-ins for all years and if more legume seeds were included in the composite, thus accounting for substitution possibilities more completely, the demand curve would tend to become less elastic and possibly inelastic.

The correlation resulting from the use of the two independent variables — gross farm income and supplies (production plus imports) — accounted for 86 percent of the year-to-year variation.[1]

During the analysis many other independent variables were tried in an attempt to account for more of the variation. Among them were various price indexes which did not improve the scatter enough to warrant the added disadvantage of explaining the price of seeds by the price of another product. Similarly, data concerning roughage-consuming animal units were used and discarded, as any improvement in the correlation came as a result of reducing the scatter in only two years, and this advantage was offset by the added variable incorporated into the analysis.

The uniformity of the scatter with numerous demand factors suggests that the error lies in the supply concept. In an attempt to correct this, carry-over was added to the years since 1939 with results shown as stars on Fig. 7. It is evident that even for these later years, carry-over does not improve the final results very much. Consumption series for 1939 to 1950 were also used but the same approximate scatter remained. This supported the conclusion that it was not worth while to try extending the consumption series back to 1929 (page 26).

Some factors influencing prices. In examining Fig. 7, it is found that the residuals for the years 1934 and 1936 are both high. This probably was the result of drouths in these years, which caused a stronger demand for seed than would be expected from income alone. Reasons for deviations of other residuals are not easily explained, but it is thought that certain other factors which influence the prices received by farmers for these five legume seeds should be discussed.

One of these factors is the substitution possibilities of other seeds. Although, as already mentioned, a composite price was used in this analysis to account for substitution among the five seeds studied, other seeds of course enter into the picture. Because of insufficient data, however, seeds such as Ladino clover could not be included.

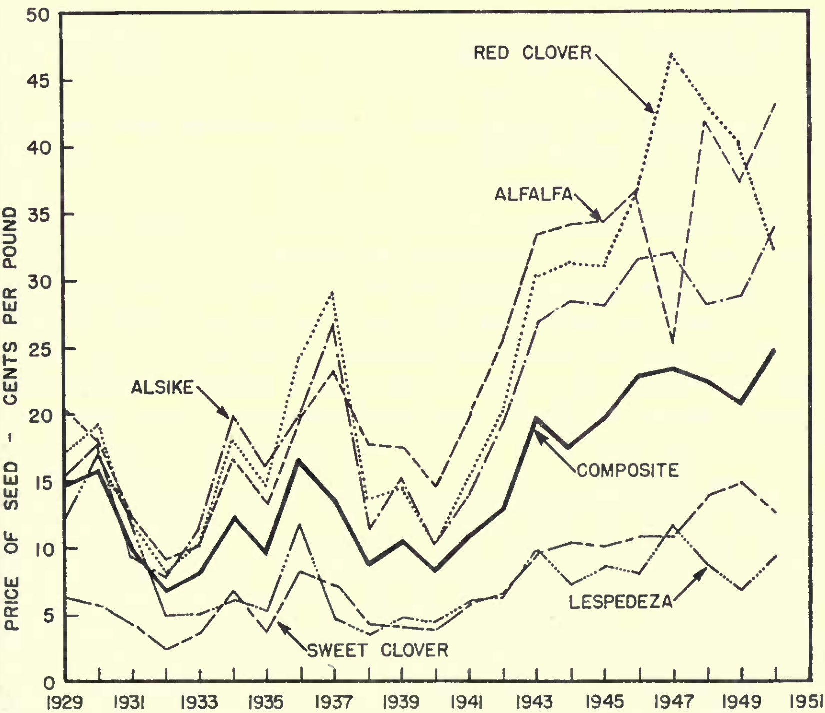
In the literature of the seed trade, weather at seeding time and hay and pasture conditions are often spoken of as important variables in the demand for seed. If fields are in good condition, farmers may delay their rotation or plant at a lower rate.

Another point to remember when analyzing price is that not all seed passes into commercial channels and hence is not directly subject to price-making forces. Some data on this can be obtained from government seed disposition reports, but they do not go back far enough for valid analysis.

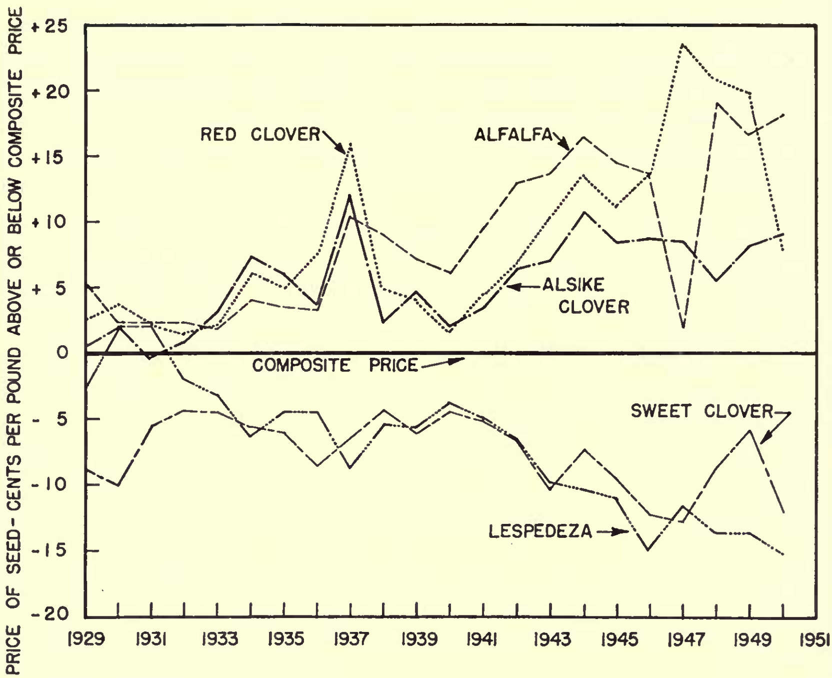
[1] Coefficient of multiple determination = .86.

Another factor that affects prices received by farmers is the estimated percentage of "clean-out." When this is high, dealers will discount the seed and when it is low, the seed will bring higher prices. From available data it appears, however, that the amount of clean-out is fairly stable and thus does not affect prices as much as one might expect.

Prices of individual seeds. Despite the limitations of this analysis, certain important relationships can be inferred from the prices of each seed as related to the composite. Fig. 8 shows the price per pound of the five legume seeds (value of production ÷ production in pounds) and the composite price. It is evident that the price of alsike clover has fluctuated around the price of red clover seed. Both remained above the composite price throughout the period, as did the price of alfalfa seed. Prices of lespedeza and sweet clover seed, however, were generally below the composite. Changes in the prices of each of the five seeds have generally been in the same direction. A major exception occurred



Relationship of the price per pound of five legume seeds to the composite price in the United States, 1929-1950. (Fig. 8)



Price deviations of five legume seeds from the composite price per pound in the United States, 1929-1950. (Fig. 9)

in 1947, when red clover seed price was at its peak while the price of alfalfa seed was at its lowest level since 1941.

Fig. 9 shows approximately the same data but in a different form. In this figure, deviations from the composite price are shown for each seed. They indicate more clearly the trend in the price of a particular seed in relation to the composite price. It is apparent that although prices of alfalfa, red clover, and alsike clover seed rose in relation to the composite price, prices of sweet clover and lespedeza seed declined.

Forecasting individual seed prices. A possible method of predicting the price of an individual seed would be to calculate the percentage which the supply of that seed is of the composite supply and relate this to the percentage that the price of the seed is of the composite price. The validity of this method would depend on the accuracy with which composite prices and supplies are predictable or known.

This procedure was used and shown for each of the five legume seeds in Fig. 10.[1] The scales are in logarithms of the percentages. In

[1] Data are given in Tables 18 and 19 of the supplement (*see* footnote 1, page 4).

Table 5. — Data Showing the Relationship Between Composite Supplies and Composite Prices of Five Legume Seeds

Seed crop	Estimation equation[a]	Standard error of estimate in logarithms	Coefficient of determination	Correlation coefficient
Alfalfa........	Y = 3.13 − .70X	.057	.56	.75
Red clover....	Y = 2.98 − .59X	.044	.74	.86
Alsike clover...	Y = 2.34 − .27X	.057	.40	.63
Lespedeza.....	Y = 2.16 − .32X	.088	.68	.82
Sweet clover...	Y = 2.16 − .39X	.071	.27	.52

[a] Y = logarithm of the percent of composite price and X = logarithm of the percent of composite supplies. Supply is equal to production plus imports.

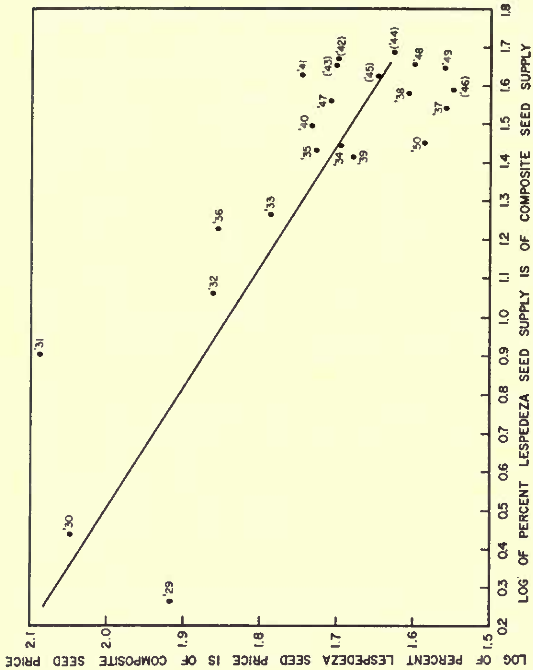
studying these figures, it should be recognized that the supply for each seed does not include carry-in. This definitely limits the analysis as carry-ins fluctuate more for individual seeds than for the composite. The equation showing the average line of relationship for each chart is given in Table 5 as are the standard error of estimate, the coefficient of determination, and the correlation coefficient.

The regression line for *alfalfa* seed explains 56 percent of the variation.[1] However, it is to be noted that all the years from 1929 to 1936 are in the lower right portion of the chart, indicating that when the alfalfa seed supply was a large fraction of the composite supply, the price was low. The years from 1937 to 1950, except for 1947, are all higher and to the left, indicating that alfalfa seed was a much smaller proportion of the composite supply and hence was higher in price. Despite the low correlation, the changes in supply of alfalfa seed relative to the composite suggests the importance of considering substitution possibilities between legume seeds in a price analysis.

The scatter for *red clover* shows a definite relationship between the percentage supplies are of the composite and the percentage price is of composite price. The regression line explains 74 percent of the variation.

The analysis of relationship for *alsike clover* seed indicates a decrease in demand. The points for 1929 to 1937 are farther up and farther right on the chart than are those for later years. The scatter suggests two possible lines of relationship: a rather steep one rather far to the right for 1929-1937 and another for the later years. Although a line showing the average relationship of the scatter does not represent the demand curve, the decreased demand can be shown by plotting residuals chronologically. In 1949 and 1950 supplies of alsike clover

[1] Coefficient of multiple determination = .56.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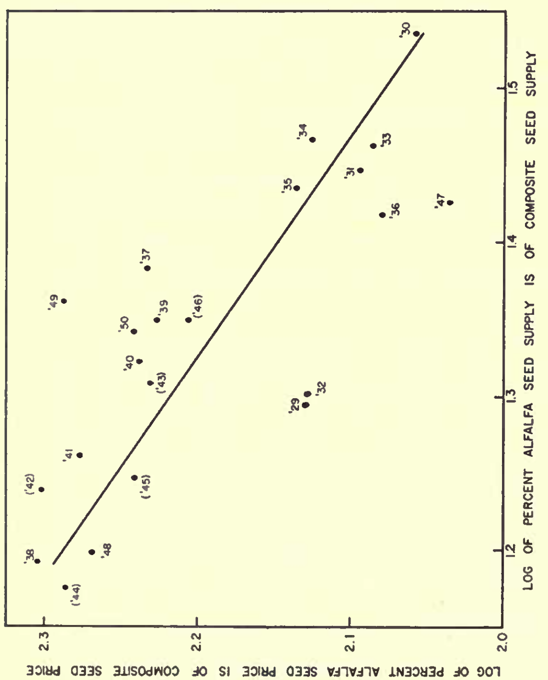
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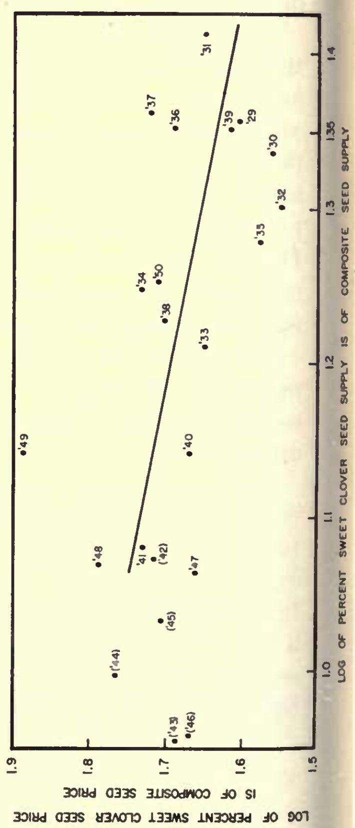
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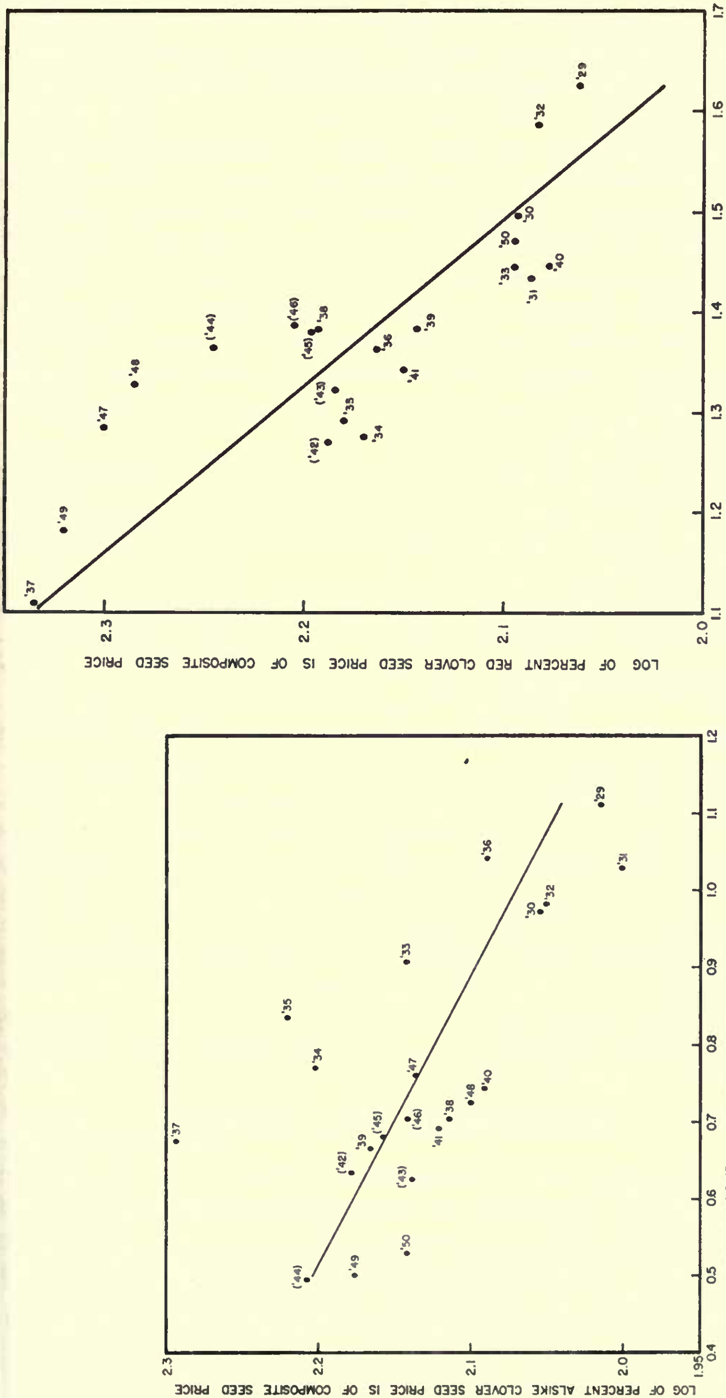


Relationships between (1) the percents that supplies of five individual seeds are of the composite supply and (2) the percents that individual seed prices are of the composite price in the United States, 1929-1950; expressed in logarithms of the percentages.

(Fig. 10)

seed were a relatively small proportion of the composite; however, prices did not rise as high as they did in the earlier years when supplies were larger, such as 1934, 1935, and 1937. On considering this from a different standpoint, we find that in 1940, 1947, and 1948, relative supplies were about equal to those of 1934 and 1935, yet prices did not rise as much. Such a result can come about only by a decrease in demand. This result is logical as alsike clover has in the past been generally used as a "catch-all" in pasture and hay mixtures. In recent years, with increased knowledge and use of soil amendments, particularly lime, soils have been made more adaptable to the superior legumes. Also, Ladino clover has been generally better than alsike clover in mixtures and has replaced alsike to some extent. In forecasting the price of this seed, one should give special attention to the regression through recent years.

Since 1931 there appears to be some relationship between relative supplies and relative price of *lespedeza* seed. As this seed has shown a very large upward trend in production, the decline in relative price appears reasonable.

No significant relationship is apparent for *sweet clover* seed. The regression through the scatter explains only 27 percent of the variation.

Price analysis of timothy seed

Reliable regressions could not be established for timothy seed because carry-ins represent a large proportion of the supply, averaging nearly 40 percent of the production for each year since 1939. The data for carry-ins are summarized in Table 4, page 26.[1] Data on carry-ins are not available before 1939 and five of the years since then were war and price-control years, so that there were not enough data for a valid analysis. Another complicating factor is that detailed data on other grass seeds are not available for a long enough time to permit analysis of the influence of competing seeds.

For all these reasons, the price analysis for this seed is confined to the description of historical price movements already given (page 16).

GEOGRAPHICAL PRICE AREAS

When we speak of the average United States price of a certain seed — alfalfa, for example — we tend to think of a particular kind or variety of seed which may or may not be the "average." Yet within the classification "alfalfa" there are a number of varieties which differ

[1] Detailed data are given in Table 16 of the supplement (*see* footnote 1, page 4).

in their adaptability to different regions. To the extent that a specific variety or type of seed is adapted to one region and not to another, we would expect to find different price-making forces at work in each region.

The purpose of this section is to show what is included in the average price of a seed and to indicate the degree of homogeneity in a particular classification of seed. If geographical price differentials are, on the average, larger than can be explained by transportation costs, the indication is that different price-making forces are in effect, or that different seeds actually occur in the same classification but are averaged together to give a United States average price. Consequently such an average might not be meaningful.[1]

Alfalfa. There are three rather definite areas of adaptation for alfalfa seed, depending on the hardiness of the varieties (Fig. 11). Seeds for hay and pasture cannot be readily interchanged between a southern and a northern area; hence seed adaptable for each area is subject to the conditions of supply and demand within the area.

Prices received by farmers in the different states were averaged for 1947-1951 and plotted on the map in Fig. 11. Lines were drawn to separate states with average prices above $25.50 a bushel, between $20.00 and $25.50, and below $20.00. It can be seen that the price areas practically coincide with the areas of adaptation.

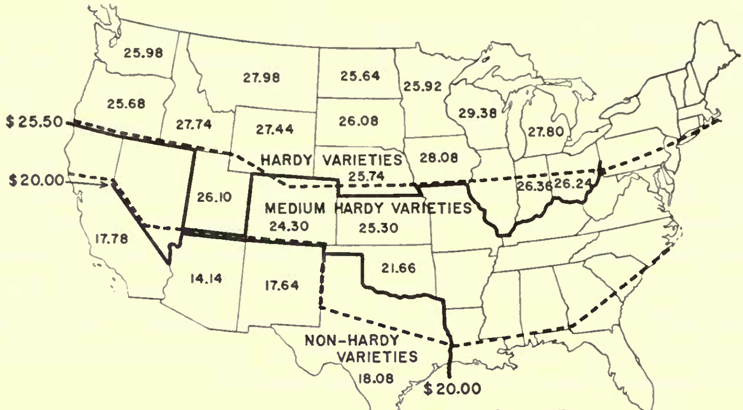
While this method gives only approximate location of geographical price areas, it does indicate the variation in average price and also its cause. The average price in the northern area is about $3.00 above that in the central area, and nearly $10.00 above the southern price. This large differential cannot be explained by transportation costs alone and is no doubt related to the areas of adaptation.

Lespedeza. Much the same situation exists for lespedeza as for alfalfa. Average price relates to different varieties of lespedeza, each adapted to a certain region and hence subject to the influences of supply and demand within that region. "Common lespedeza, of which Kobe is the most used variety, is especially adapted to the southern third of the lespedeza area, while Korean is especially suited to the more northern part."[2]

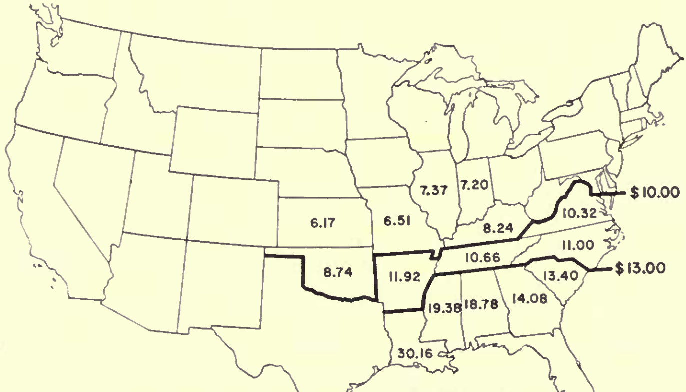
Fig. 11 shows the geographical price areas for this seed. Prices averaged $7.37 per hundred pounds in the central area, $10.98 in the

[1] Average prices by states and areas for the six seeds are given in Tables 20-25 of the supplement (*see* footnote 1, page 4).

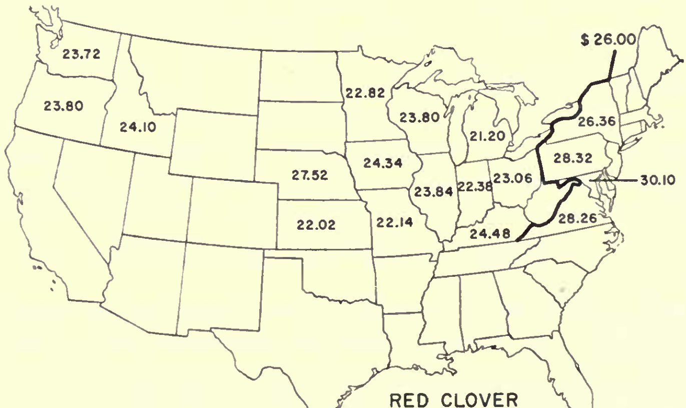
[2] U. S. Department of Agriculture Yearbook for 1948. pp. 709-711.



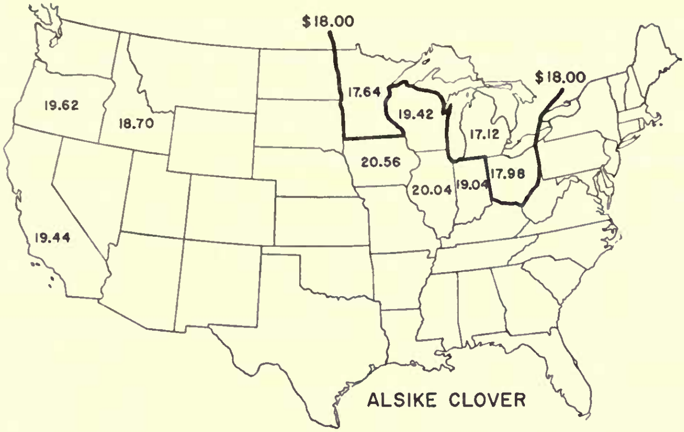
ALFALFA

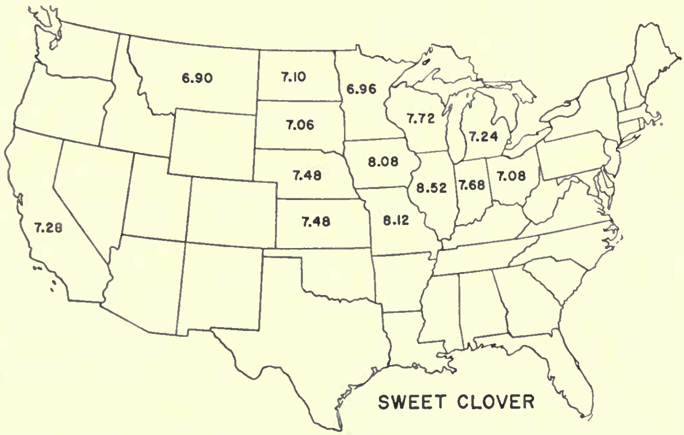


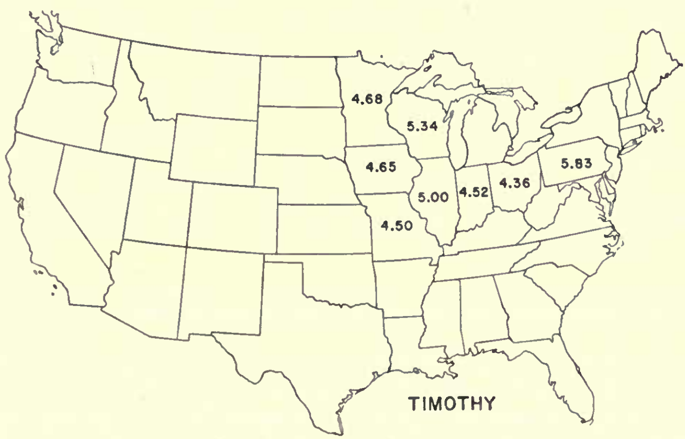
LESPEDEZA



RED CLOVER







Average price, by geographical location, that farmers received for six seeds, 1947-1951. Also shown are the areas of adaptation for hardy, non-hardy, and medium hardy alfalfa varieties. (Fig. 11) south-central area, and $16.41 in the southern area (without Louisiana). The differences are significant enough to indicate that average prices may not be meaningful for a price analysis unless we know the proportion of the seed of the different varieties and something as to the factors influencing the supply and demand.

Other seeds do not show the price differentials by areas that alfalfa and lespedeza do. Instead, price differences probably reflect to a large extent surplus and deficit areas with transportation costs accounting for a large fraction of the differential.

In general, this appears to be the situation for red clover seed (Fig. 11), with the middle Atlantic states being a deficit area. However, the Northwest, a surplus-producing area, shows a higher average price than the consuming area of the central states. This can be explained by the fact that the Northwest produces a larger proportion of improved varieties than does the rest of the country. While certain varieties of red clover have definite areas of adaptability, this analysis is not detailed enough to show any differential resulting from this cause alone.

Sweet clover seed shows very little geographical differential in prices except for a central core of three states (Illinois, Iowa, and Missouri), where the average price was $8.24 a bushel compared with $7.27 for the other 11 producing states (Fig. 11). These three states were probably deficit-producing states during the period studied.

Timothy seed also shows very little price differential by location. Iowa shows a fairly low price as it is the heart of the timothy seed-producing region and is a surplus state.

Geographical price patterns seem apparent for alsike clover seed, with Minnesota, Michigan, and Ohio having the lowest average price — $17.58 a bushel — and Indiana, Illinois, and Iowa having the highest average price — $19.88 a bushel (Fig. 11). The latter three states are in the heart of the consuming area and are likely to be deficit states with the shift in seed production to the Northwest. The northwestern states and California, on the other hand, are surplus-producing states and so show an average price below that for the central corn-belt states.

How geographical areas affect price analyses

It is apparent from the above material that two important considerations in the price analysis of a particular seed are (1) the extent to which different types of seed are adapted only to particular locations and (2) the number of possible substitutions for each type of seed.

Prices fluctuate widely. The effect on price of variations in adaptability and substitution possibilities of different varieties can best be illustrated by considering alfalfa. As we have seen, hardy, medium hardy, and nonhardy alfalfa seeds are each adapted to a rather definite region. As the variegated varieties (hardy types) are generally superior to common varieties north of the fortieth parallel, it is reasonable to suppose that there is a large potential demand for these superior varieties. As a result, changes in the quantities of improved adapted varieties of seeds will cause prices to fluctuate considerably more than if farmers could substitute other varieties more readily.

In years when production of seed of the variegated varieties is low, farmers tend to bid up the price, even though the supplies of other types may be large and the total supply normal. The result may well be to raise the average price for all alfalfa seed so that it would be higher than expected on the basis of total available supplies. If in a particular year supplies of adapted variegated varieties are relatively large, the result would probably be lower prices for the variegated varieties and hence a much lower average price for all alfalfa seed.

As yet, comparable prices for the different types of alfalfa are not available for a long enough period to illustrate these points statistically. It can readily be seen, however, that for a good understanding of the behavior of alfalfa seed prices, the price of each type, as well as the proportion of each in the total supply, should be known.

Although red clover does not have as much diversity in types and varieties as alfalfa has, somewhat the same problem exists in analyzing this crop. As farmers become better acquainted with the varieties adapted to their locality they begin to think in terms of a specific variety and hence each variety responds to particular supply and demand forces. For example, a short supply of Kenland red clover seed in a year when production of red clover seed is large may cause a higher average price than the total supply of red clover seed would indicate, as certain farmers are convinced of the superiority of Kenland and are willing to pay a good price for it.

For other forage seed crops the same situation may prevail in varying degrees, depending on varieties and strains available.

Elasticity of demand is affected. The substitution possibilities or lack of substitution will affect the elasticity of demand[1] for a particular

[1] Degree of elasticity will vary for both supply and demand depending upon the period involved. Demand is likely to be least elastic when data for a year are considered, and is more elastic either for an instantaneous or market period or for a period longer than a year. Here we are considering the elasticity shown in a year, or the period which will ordinarily show the least elasticity.

seed. It is reasonable to conclude that the demand for all seeds is inelastic as there are no substitution possibilities for forage seeds except to let the present stand remain for another year. As a result, prices would be expected to fluctuate proportionately more than the change in quantity supplied. But when we consider a specific seed the demand may be elastic if important substitution possibilities are available. For seeds with few substitution possibilities, the demand will be relatively inelastic.

A complicating element is that elasticities of demand for the same crop will vary from farm to farm and from area to area as the result of differences in soil, climate, and rigidity of the rotation.

While these considerations are not readily measured and hence not easily analyzed by statistical methods, they should be understood by those concerned with producing, buying, or selling seed. The analysis in qualitative terms of these tendencies can be extended to any seed if knowledge of economic behavior is combined with accurate information about the seed.

Future studies desirable

It is suggested that for future investigations, supplies and prices of different varieties or groups of varieties should be considered, since prices of each respond to different demand conditions depending upon the area of adaptation. Such an analysis was not undertaken in this study because prices of the different types of seeds were not available for a long enough period to draw valid conclusions.

MARKETING MARGINS

In Table 6 is shown, for the six seeds studied, the average share of the retail dollar going to the farmer, the retailer, and the wholesaler during the 1926-1950 period.[1, 2] Analyses of year-to-year trends, size and fluctuations of the margins, and the relationship of retail prices to farm prices are made in the following paragraphs.

Trends since 1926

Fig. 12 shows graphically for the six seeds the percentages of the retail dollar going to the farmer, the wholesaler, and the retailer. It is evident from these charts that since the early 1920's the farmer's share of the retail dollar has declined for all the seeds except lespedeza.[2]

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[1] Data for each year are given in Table 26 of the supplement (*see* footnote 1, page 4).

[2] Data studied for lespedeza seed go back only to 1933.

Table 6. — Average Share of the Retail Dollar Going to Each Level in the Marketing System for Six Forage Seeds, 1926-1950
(Omitting the price-control years, 1942-1946)

Seed crop	Farmer's share	Wholesale share	Retail share
		percent	
Lespedeza[a]	70.4	11.5	18.1
Red clover	68.6	23.1	8.3
Alfalfa	65.1	19.1	15.8
Alsike clover	63.2	25.7	11.1
Sweet clover	53.7	29.9	16.4
Timothy	51.8	27.4	20.8

[a] For the period 1933-1950, omitting 1942-1946.

Margins for *sweet clover* and *timothy* seed are characterized by rather sharp declines in the farmer's and retailer's shares of the dollar and an increasing share for the wholesaler. Comparing price relatives for these two seeds with the price received by farmers for all crops shows that the price received by farmers has tended to decline in recent years. As marketing costs have remained high or have increased, the total margin between farmer and retail purchaser would be expected to increase.

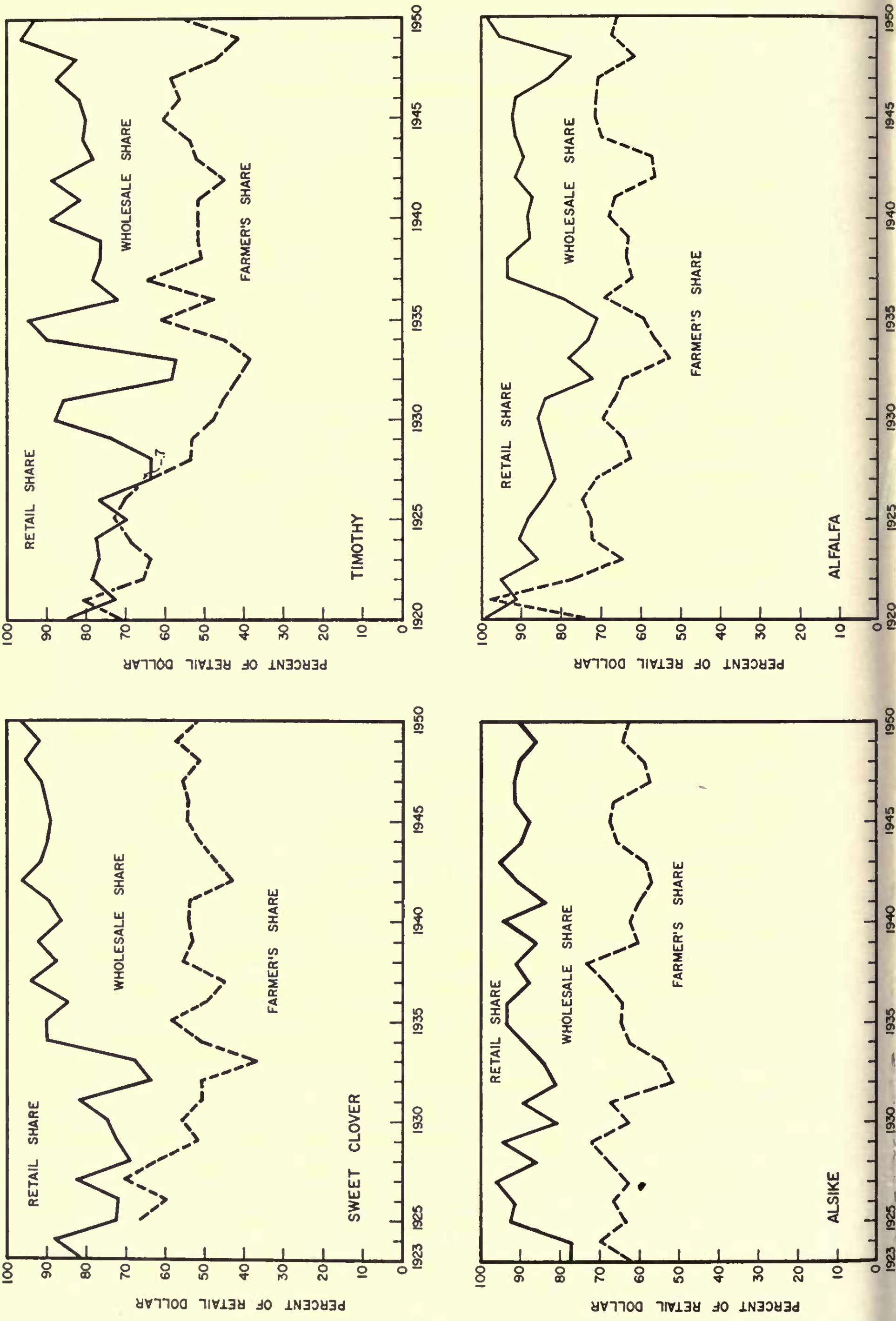
Margins for *red clover* seed show very little trend of significance: The downward trend in the farmer's share of the dollar is only a result of high percentage returns in the 1920's. The wholesaler's share has tended to increase over the period studied.

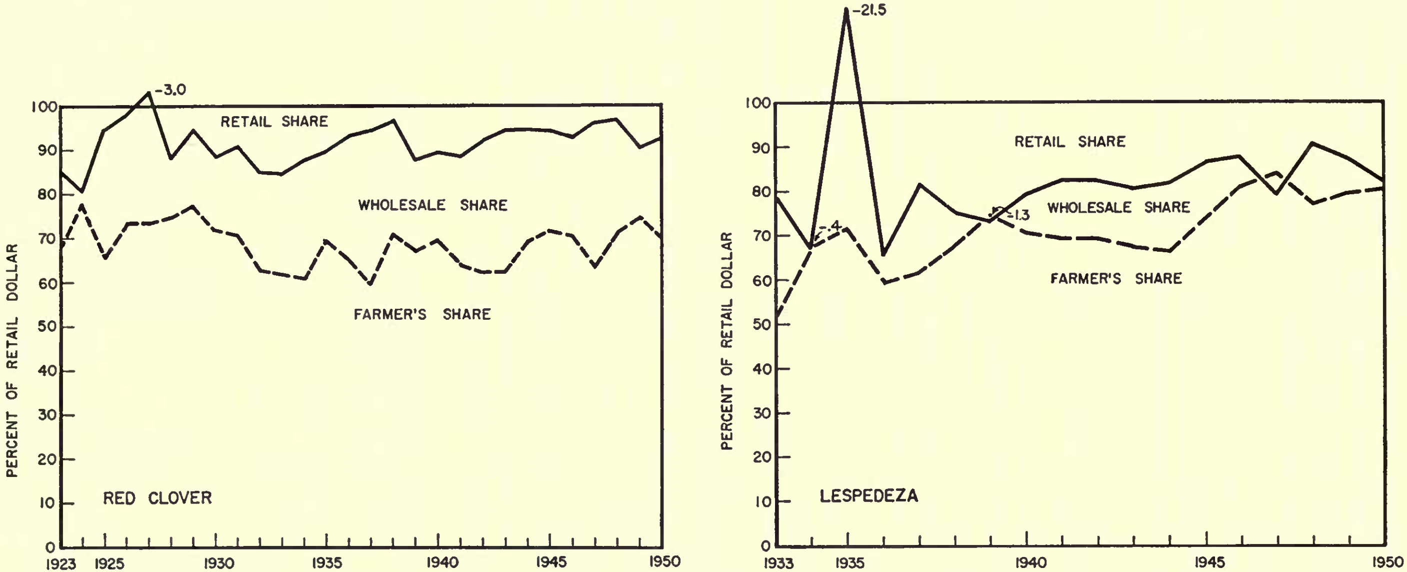
Alsike clover seed has shown a slightly but constantly decreasing percentage return to the farmer. This may have resulted from the shift of the alsike clover seed-producing region to the northwest with accompanying higher costs of transportation to the consuming area. There is no apparent trend in the relative shares going to wholesaler and retailer.

The farmer's relative share of the *alfalfa* seed dollar decreased fairly rapidly until the early 1930's, but since that time has been slowly increasing. The wholesaler's relative share increased over the period studied while the retailer's share increased until the midthirties and subsequently declined.

The retail dollar for *lespedeza* seed is characterized by a rising share to farmers, a declining share to retailers, and a widely fluctuating share to wholesalers.

From this short discussion several important relationships become apparent. First, for seeds that are increasing fairly rapidly in production, there has tended to be an increasing share of the dollar returned


TIMOTHY
RETAIL SHARE
WHOLESALE SHARE
FARMER'S SHARE
PERCENT OF RETAIL DOLLAR
ALFALFA
SWEET CLOVER
ALSIKE
100
90
80
70
60
50
40
30
20
10
0
1920
1923
1925
1930
1935
1940
1945
1950



How the retail dollar spent for each of six legume and grass seeds has been divided among the farmer, the wholesaler, and the retailer. (Fig. 12) to the farmer. This has been true of both lespedeza and alfalfa since the early 1930's. There is further evidence that the increasing demand for these seeds in the early periods resulted in large markups by the retail trade with a larger relative share of the dollar going to the retailer. Seeds with decreasing price relatives (in comparison with prices received by farmers for all crops), such as timothy and sweet clover, are characterized by a declining share of the retail dollar going to the farmer and an increasing proportion going into the marketing margin.

Relative variability of total margins

Table 7 shows the variability in the total margin for each seed. It might be expected that seeds having the greatest variability in production would also show the greatest variability in the total margin (wholesale share plus retail share). The variation in production for each seed crop, already shown in Table 2, is included in Table 7 so that comparisons can be readily made. The standard deviation is divided by the average margin and multiplied by 100 to give Pearson's coefficient of variation. This reduces the standard deviations to terms which are comparable. Direct comparisons of the various standard deviations are not adequate, as a standard deviation of 1 percent on an average margin of 50 percent represents less of a fluctuation than does the same standard deviation on an average margin of 25 percent.

The data in Table 7 tend to confirm the hypothesis that variations in production are related to variations in marketing margins. Alfalfa, alsike clover, and sweet clover seed show about the same variation in total production and also have coefficients of variation of about the same magnitude. Timothy seed shows the highest variation in production and also the largest coefficient of variation of the margin. Varia-

Table 7. — Variation in Total Margins as Related to Variation in Total Production, 1926-1950

Seed crop	Average percentage change in production from preceding year	Average total margin in percentage	Standard deviation of the margin	Coefficient of variation of the margin
Timothy	117.8	48.2	25.99	53.9
Lespedeza[a]	39.8	29.6	8.66	29.3
Red clover	42.5	31.4	5.09	16.2
Alfalfa	21.8	34.9	4.99	14.3
Alsike clover	22.7	36.8	5.18	14.1
Sweet clover	22.5	46.3	6.31	13.6

[a] For the period 1933-1950.

tions in production of red clover and lespedeza seed fall in between these two extremes as do their respective coefficients of variation of the margins. It must be remembered, however, that data for lespedeza seed are not strictly comparable with the other data.

Size of total margin

In addition to the relationship between variability in production and variability in margins, one might expect a further relationship between fluctuations in production and the size of the margin. That is, seed production which is unstable would be expected to show the highest margin as the industry must cover the higher risks involved. Timothy seed, however, is the only one that meets this hypothesis.

For the other seeds additional factors are evidently involved — probably variations in the conditions of demand and location of the production and consumption areas. For red clover, for example, the area of consumption is identical with the area of production, so that the total margin would probably be somewhat less than would be indicated by variations in production alone. Because of these various interrelated forces, no general conclusion is made in regard to the size of the margins.

Relationship of retail prices to prices received by farmers

In Fig. 13 the retail price of each seed is plotted against the price received by farmers, and the line of average relationship is fitted by the method of least squares. This relationship covers the period 1926-1950, omitting 1942-1946. The variation from this line is shown by the coefficients in Table 8 for each of the seeds. For all seeds except lespedeza, the line of average relationship accounts for the retail price with high correlation if the average price received by farmers is given.

Table 8. — Data Indicating the Relationship Between Price Received and Retail Price for Six Forage Seed Crops in the United States, 1926-1950

Crop	Regression equation	Standard error of estimate	Coefficient of determination	Index of correlation
Lespedeza[a]	$Y = .633 + 1.332X$	1.36	.87	.93
Timothy	$Y = .829 + 1.767X$	1.82	.94	.97
Alsike clover	$Y = .759 + 1.533X$	2.43	.96	.98
Alfalfa	$Y = 2.082 + 1.423X$	1.75	.98	.99
Sweet clover	$Y = .565 + 1.759X$	.77	.98	.99
Red clover	$Y = 2.033 + 1.352X$	1.62	.99	.99

[a] For the period 1933-1950.

These charts may be useful in indicating the retail price as soon as the crop moves into the marketing channel from the farmer, as the average price received by farmers will be determined before the retail price. However, the retail price will be affected to some extent by the economic conditions existing at planting time. The usefulness of the charts in predicting retail prices before seeds are marketed depends upon how well the farm price can be forecast.

Other forces affecting margin

In conclusion, several other forces should be mentioned which have a bearing on the margins for all the seeds. Over the period studied the seed industry has increased its services. Expanding or adding such services as purity and germination tests, packaging in smaller containers, and handling improved varieties and certified seeds has increased cost of handling. These added costs have tended to increase the wholesaler's share of the retail dollar (Fig. 12). However, an opposing tendency is the fact that as prices have risen since the depression years, marketing costs generally have been "inflexible" and hence have not risen as fast as the price of the product.

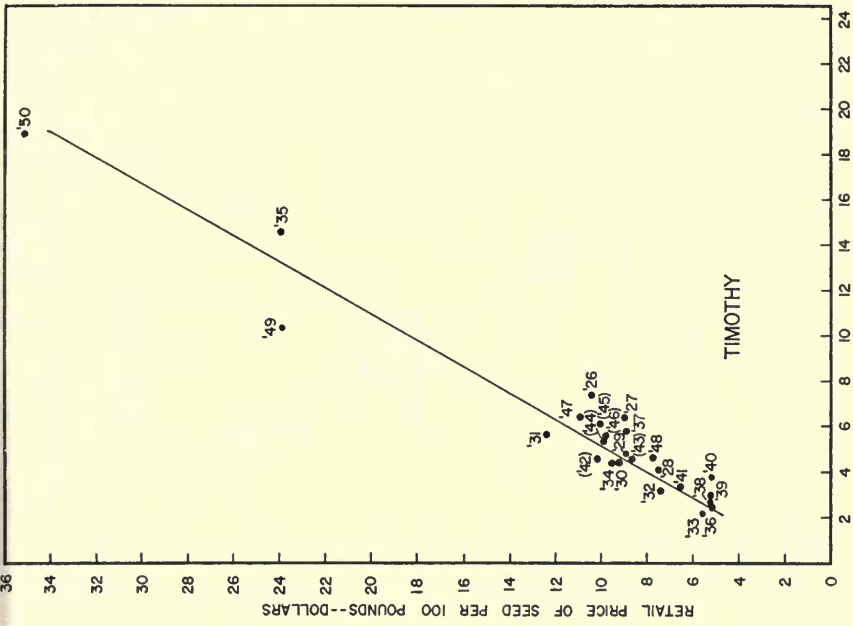
SUMMARY

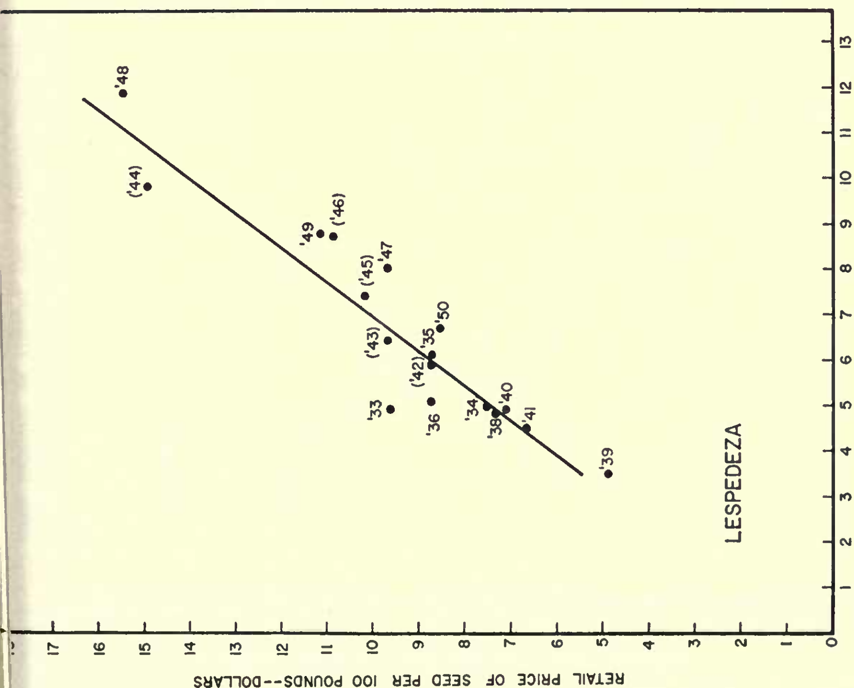
This study was limited to the six forage seed crops having the highest average money value from 1940 to 1949: red clover, alfalfa, lespedeza, alsike clover, sweet clover, and timothy.

Red clover and alsike clover seed are produced mainly in the Midwest and Northwest; timothy and sweet clover in the Midwest; alfalfa throughout the western half of the country; and lespedeza in an area south of the corn belt, north of the cotton belt, and extending from the Atlantic to Oklahoma and Kansas.

Lespedeza seed production increased rapidly from 1920 to 1939 but has tended to level off since then. Production has decreased for sweet clover and timothy seed, increased for alfalfa and red clover, and remained rather constant for alsike clover. Although imports were relatively unimportant on the whole, they were of considerable importance for individual seeds in particular years. Only timothy seed was exported in any quantity. Carry-ins averaged 10 to 15 percent of total production, amounting to as much as 30 percent in some years.

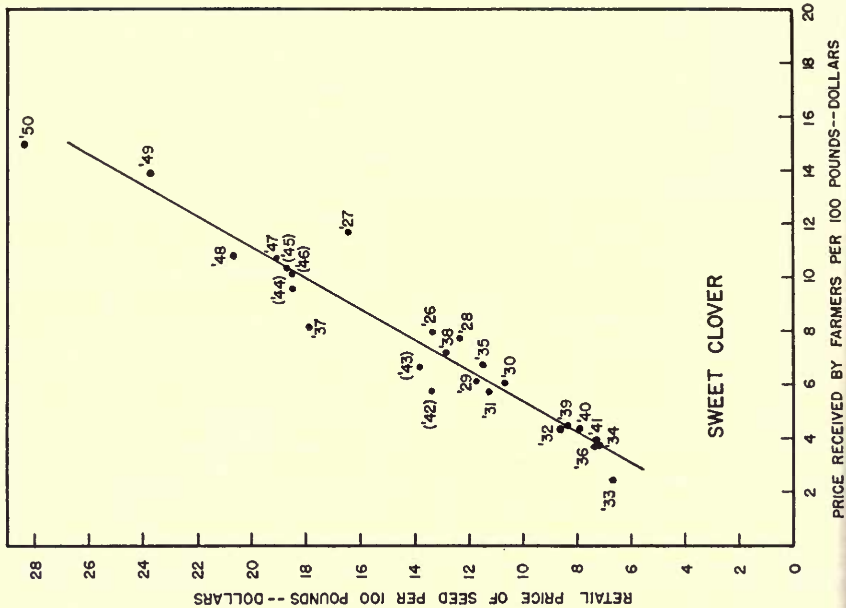
Changes in acreage account for most of the changes in seed-crop production. Prospective yield and prospective price probably influence acreage harvested, though these are not statistically measurable.

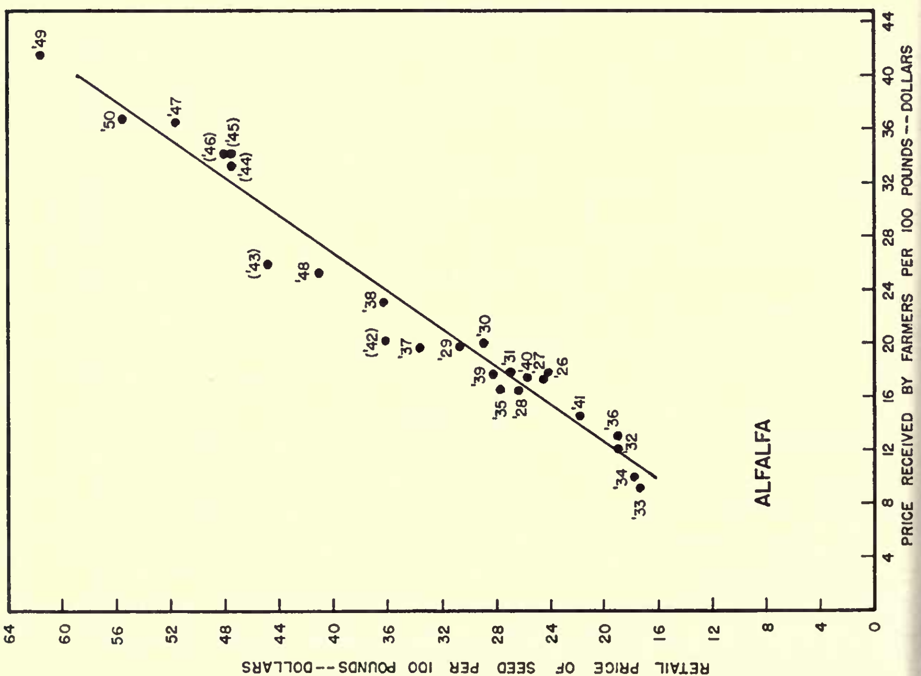


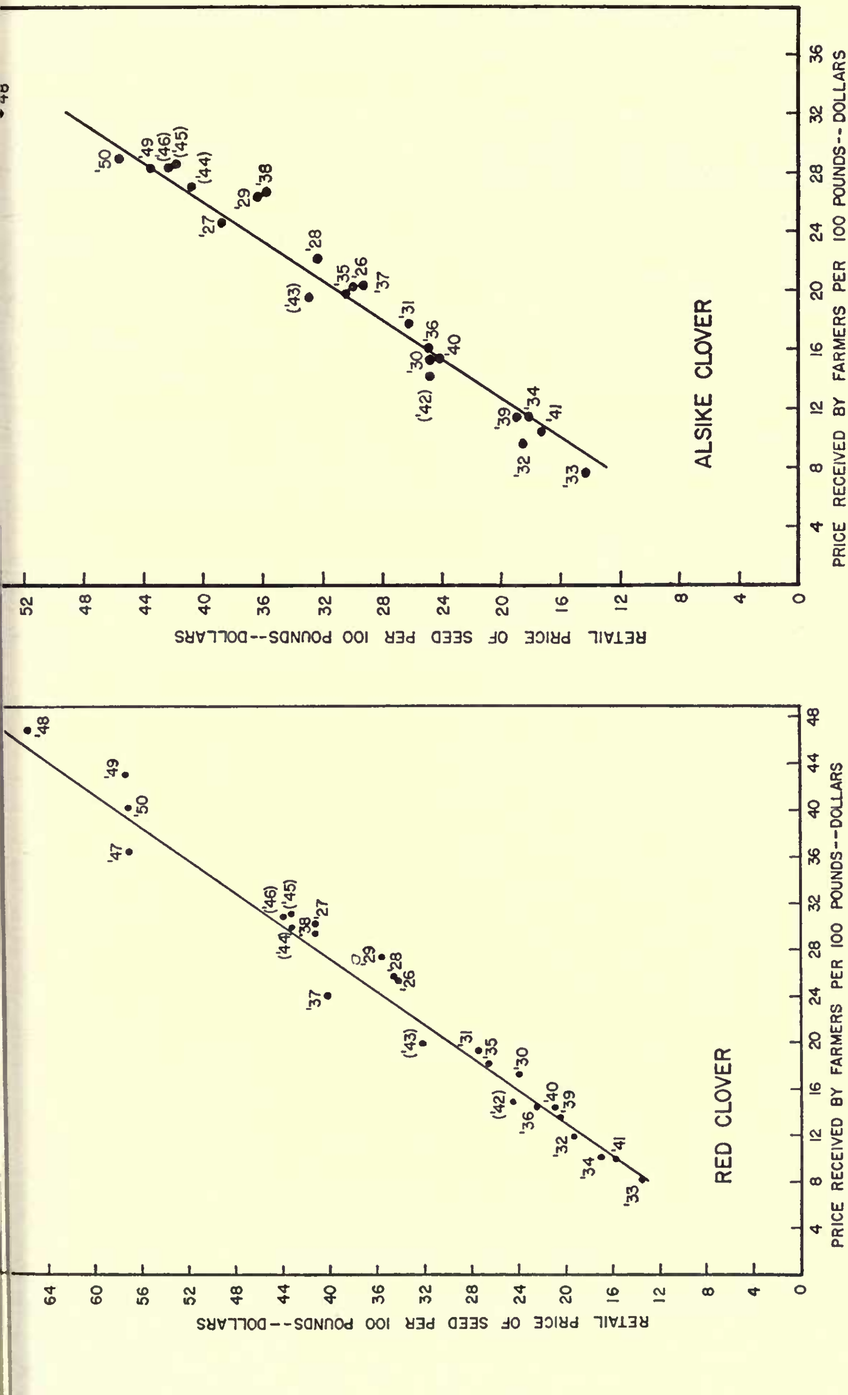


Relationship of retail seed price of lespedeza (1933-1950) and timothy (1926-1950) to price received by farmers. (Fig. 13)

(Fig. 13 is continued on next page.)


SWEET CLOVER
RETAIL PRICE OF SEED PER 100 POUNDS -- DOLLARS
PRICE RECEIVED BY FARMERS PER 100 POUNDS--DOLLARS


ALFALFA
RETAIL PRICE OF SEED PER 100 POUNDS--DOLLARS
PRICE RECEIVED BY FARMERS PER 100 POUNDS--DOLLARS



Relationship of retail seed price of red clover and alsike clover to price received by farmers, 1926-1950.
(Fig. 13, concluded)

Farmers received the lowest prices in fall, and the highest in spring, the difference being great enough that it would pay Illinois farmers to store their seed until spring.

Among the factors determining seed prices are: gross farm income (used as a measure of demand), price of competing seeds, and total supply, including supplies of competing seeds. Seeds vary in substitution potentialities from area to area, depending on soil types, type of farming, and disease problems. These conditions alter the price-making forces in different areas. Hardy and nonhardy alfalfa varieties, for example, which are adapted to the northern and the southern part of the United States respectively, show such great price differentials that they should probably be treated as two different commodities in a price analysis.

The portion of the retail dollar going to the farmer has tended to decline, with only lespedeza showing a marked reversal of this trend. Seeds showing a wide year-to-year variation in production also have a wide variation in their margin.

Probably many persons connected with the seed trade have reached these conclusions from their own observations. This report should serve not only to confirm these observations but also to make them available to others who want more insight into the behavior of seed prices.

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